

THIS MEMO

PERTAINS TO #
DOCS. # 5421, 5422
+ # 5423

MEMORANDUM

August 21, 1991

TO: BOSTON REDEVELOPMENT AUTHORITY AND
STEPHEN COYLE, DIRECTOR

FROM: PAUL BARRETT, ASSISTANT DIRECTOR
VICTOR KAREN, DEPUTY DIRECTOR
DON KLABIN, SENIOR PROJECT MANAGER
HARBOR PLANNING AND DEVELOPMENT
KAREN GRAY, SENIOR PLANNER
RICHARD MERTENS, ENVIRONMENTAL REVIEW OFFICER

SUBJECT: SECTION 61 FINDINGS REGARDING: BUILDING A OF THE PROPOSED
BIOMEDICAL RESEARCH CENTER AT PARCEL 7, THE PROPOSED HOTEL
ON PARCEL 4 AND THE MARINA ON PIER 9.

SUMMARY: THIS MEMORANDUM REQUESTS ADOPTION OF SECTION 61 FINDINGS AND AUTHORIZATION TO FILE THE SECTION 61 FINDINGS REGARDING BUILDING A OF THE PROPOSED BIOMEDICAL RESEARCH CENTER AT PARCEL 7 IN THE CHARLESTOWN NAVY YARD; THE PROPOSED HOTEL ON PARCEL 4; AND THE PROPOSED MARINA ON PIER 9. THE PREPARATION OF THESE FINDINGS WAS REQUESTED IN THE DECISION OF THE SECRETARY OF ENVIRONMENTAL AFFAIRS DATED JANUARY 2, 1991 REGARDING THE NOTICE OF PROJECT CHANGE DATED OCTOBER 31, 1990.

On October 11, 1990, the Boston Redevelopment Authority ("BRA") voted to adopt the Charlestown Navy Yard Master Plan. Subsequently, a Notice of Project Change ("NPC") was submitted to the Commonwealth of Massachusetts Executive Office of Environmental Affairs ("EOEA") describing the changes proposed by the Master Plan dated October 1990 from prior State approvals pursuant to the Massachusetts Environmental Policy Act ("MEPA").

In response to the NPC, EOEA requested that the BRA submit a Section 61 Finding ("Finding") describing the following five (5) environmental impacts on Building A of the proposed Biomedical Research Center to be built at Parcel 7 in the Yard's End area of the Charlestown Navy Yard: wind, shadow, height, massing, and public accessibility. EOEA also requested that the BRA submit the Pier 9 site plan, and circulate it to parties who commented on the Notice of Project Change. Lastly, EOEA requested that the BRA prepare a Section 61 Finding, describing the following environmental impacts of the proposed hotel on Parcel 4: wind, shadow, and other conditions of the ground level pedestrian environment, including visual access considerations.

Building A

In summary, the finding indicates that there are only minor adverse impacts in each of the five categories listed above, and that all feasible mitigation measures have been taken by the BRA to avoid or minimize the environmental impacts associated with the development of Building A at Parcel 7.

The filing of the Finding with the Commonwealth of Massachusetts at this time would complete the MEPA review of the Building A project at Parcel 7 and, thereby, expedite the start of construction. Accordingly, it is requested that the BRA adopt the attached Finding and authorize the Director to submit the Section Findings regarding Building A at Parcel 7 to EOEA pursuant to the MEPA regulations.

Pier 9 Marina

The Pier 9 Marina project consists of the development of a private marina containing up to 150 marina slips, together with accessory marina uses which may be constructed on the remaining portions of Pier 9 in the Charlestown Navy Yard, and up to 12,000 square feet of restaurant, yacht club, and accessory uses on adjacent Pier 8. Pursuant to the Harborpark District (Charlestown) Zoning and the Boston Municipal Harbor Plan, the maximum allowed building height of any accessory marina use shall be 35 feet. The environmental impacts of the development of the Pier 9 Marina have been evaluated in the Final Environmental Impact Report for the proposed Charlestown Navy Yard Development, dated January 31, 1977.

Therefore, it is also requested that, with respect to the Pier 9 Marina, the attached Finding that all feasible mitigation measures have been taken by the BRA to avoid or minimize environmental impacts be adopted. In accordance with the Secretary's decision a detailed site plan of the marina will be submitted and circulated to those who have commented on the NPC.

Parcel 4 Hotel

Wind and shadow studies which include the Parcel 4 Hotel have been conducted for submission in the Final Supplemental Environmental Impact Report (FSEIR) for the Charlestown Navy Yard. These studies indicate minimal adverse impacts on the ground level pedestrian environment, and that all feasible mitigation measures have been taken by the BRA to avoid or minimize these environmental impacts associated with the project.

As other conditions of the ground level pedestrian environment, including visual access considerations, study indicates that all feasible mitigation measures have been taken by the BRA to avoid or minimize harm to the environment. The design of the hotel has been modified in consultation with the Massachusetts Historical Commission, the Boston Landmarks Commission, and the Advisory Council on Historic Preservation. This process has resulted in the massing of the building originally approved by the Secretary in a "dumbbell" shape, being moved to the northern side of the site.

In addition, thirty townhouse condominiums originally approved for the water's edge have been deleted from the Parcel 4 plan. This deletion results in a continuous Harborwalk, improving both physical and visual access to the waterfront. Through deletion of the townhouses, privatization of this portion of the waterfront is avoided.

Accordingly, it is requested that the BRA adopt the attached Finding regarding the Parcel 4 hotel and authorize the Director to submit the Section 61 Finding regarding the Hotel at Parcel 4 to EOEa pursuant to the MEPA regulations.

Appropriate votes follows:

VOTED: That the Authority hereby adopts the attached Finding entitled "M.G.L. Chapter 30, Section 61 Finding on Building A of the Biomedical Research Center, Charlestown Navy Yard Redevelopment," and authorizes the Director to submit the Finding to the Commonwealth of Massachusetts Executive Office of Environmental Affairs; and #5421

FURTHER
VOTED: That the Authority hereby adopts the attached Finding entitled "M.G.L. Chapter 30, Section 61 Finding on Parcel 4 Hotel, Charlestown Navy Yard Redevelopment," and authorizes the Director to submit the Finding to the Commonwealth of Massachusetts Executive Office of Environmental Affairs; and #5422

FURTHER
VOTED: That the Authority hereby adopts the attached Finding entitled "M.G.L. Chapter 30, Section 61 Finding on Pier 9 Marina, Charlestown Navy Yard Redevelopment," and authorizes the Director to submit a detailed site plan of the marina to the Commonwealth of Massachusetts Executive Office of Environmental Affairs. #5423

Figure 1 Site Identification Map



Doc. # 5422
ADOPTED 8/21/91

**M.G.L. CHAPTER 30, SECTION 61 FINDING
ON THE CHARLESTOWN NAVY YARD HOTEL,
CHARLESTOWN NAVY YARD REDEVELOPMENT**

By the Boston Redevelopment Authority

August 21, 1991

The Boston Redevelopment Authority (BRA) is filing this Section 61 Finding relating to the Hotel on Parcel 4, containing approximately 400,000 square feet of space and including 400 rooms, dining facilities, and other facilities of public accommodation. This Finding is made with the Secretary of Environmental Affairs in accordance with the Massachusetts Environmental Policy Act (MEPA) (M.G.L. Chapter 30, Section 61) and its implementing regulations (310 CMR 11.10 (3)) and in accordance with the January 2, 1991, certificate of the Secretary.

This document contains a discussion of the purpose of the Section 61 Finding, the scope of the Finding, the environmental impacts created by the project, the measures the BRA will take to avoid or minimize those impacts, and the BRA's Section 61 Finding.

The Purpose of the Section 61 Finding

Pursuant to 301 C.M.R. 11.10 (3), any agency which acts on a project for which a Section 61 finding is required "must determine the impact on the environment of such projects, make a finding describing such impact, if any, and make a finding that all feasible measures have been taken to avoid or minimize the impact."

Scope of the Section 61 Finding

The MEPA process for the redevelopment has been scoped to include all environmental impacts. As discussed below, in his decision of January 2, 1991 on the Notice of Project Change for the Charlestown Navy Yard redevelopment, the Secretary of Environmental Affairs directed that three specific issues be addressed in the Section 61 Finding on the Charlestown Navy Yard Hotel: wind, shadow, and other conditions of the ground level pedestrian environment. Accordingly, the focus of this Section 61 Finding is on the three issues identified by the Secretary. However, a general finding is also made.

MEPA History

On January 31, 1977, the BRA submitted a Final Environmental Impact Report (FEIR) for the proposed Charlestown Navy Yard Redevelopment to the Executive Office of Environmental Affairs (EOEA). In response to comments by the Secretary of EOEA, dated March 1, 1977,

the BRA submitted an Addendum to the FEIR, dated January 1978. On February 19, 1978, the Secretary issued a certificate approving the FEIR.

On October 31, 1990, the BRA filed a Notice of Project Change (NPC) respecting changes in the proposed redevelopment program. In that NPC, the BRA requested the Secretary:

1. to determine that Building A of the proposed Biomedical Research Center, the hotel, and the Pier 9 marina require no further MEPA review;
2. to determine that issues of traffic, air quality, infrastructure, historic preservation, and waterways have been adequately studied with respect to the new development plan; and
3. to provide scoping information, if necessary, for the remainder of the Biomedical Research Center and Aquarium.

In his response dated January 2, 1991, the Secretary determined that Building A and the hotel would not require the submission of a supplemental environmental impact report. However, in anticipation of conditions contained in the Secretary's later decision, dated May 22, 1991, on Boston's Municipal Harbor Plan, the Secretary required the filing of a Section 61 Finding addressing issues related to Chapter 91 of the General Laws. The Secretary stated:

Based upon the factors cited in 301 CMR 11.17, it is my opinion that this proposed hotel does not significantly increase the environmental impacts of the earlier approved 700-room hotel. However, because of the development of new waterways regulations in the years since the FEIR was approved, some aspects of the hotel, such as height, are now subject to regulation. Therefore, in order to develop mitigation measures regarding wind, shadow, and other conditions of the ground level pedestrian environment (including visual access considerations), the BRA should prepare a Section 61 Finding, to be submitted to the Secretary for public review and comment prior to issuance of the Chapter 91 permit. The Section 61 Finding will supply the Department of Environmental Protection (DEP) with a reasonable amount of site-specific information for licensing purposes. Any additional changes to the proposed hotel must be submitted to the MEPA Unit as a NPC and circulated accordingly.

The Secretary deferred determinations on the second and third requests pending submission, respectively, of (i) the revised Master Plan, to be treated as a Draft Supplemental Environmental Impact Report (DSEIR) and (ii) Environmental Notification Forms (ENFs) for Buildings 2 [B] and 3 [C] of the Biomedical Research Center and the Aquarium.

Environmental Impacts Caused by the Project

The Secretary has identified three impact areas to be the focus of this Section 61 Finding. They are: wind, shadow, and other conditions of the ground-level pedestrian environment (including visual access considerations).

Wind -

For the most part, Boston's weather is dominated by three different wind directions: northwest (winter), southwest (summer), and easterly (storm) winds. As explained in detail in a pedestrian level wind study undertaken by Frank H. Durgin, P.E., which is presented in Appendix A, the impacts to these three prevailing wind patterns caused by the Navy Yard redevelopment, and specifically the Hotel, are as follows:

Northwest (winter) Winds - The Hotel has three entrances. The one on First Avenue is in the middle of a 30-foot high low part and is shielded from the northwest winds by both Building 106 across First Avenue and by Building 199 further upstream. The second entrance, at the southeast end of the 135-foot high wing, is in the lee of the building for northwest winds. Winds at both locations should be comfortable for periods of short exposure. The main entrance to the Hotel is under a 30-foot extension (arcade) to the 135-foot high wing and thus would be very protected from all winds. Northwest winds between the west corner of the Aquarium and the southeast end of the main entrance to the Hotel will be speeded up because of the wind being forced through a narrow gap between the Hotel and the Aquarium. However, winds at the main entrance will remain unaffected because of its protected location. Also, due to its location with respect to northwest winds, the Hotel should have little or no effect on winds in the Yard's End Park or on the Harborwalk.

Southwest (summer) Winds - For southwest winds, the main entrance to the Hotel will be in the lee of the Hotel and thus the winds will be very calm at this location. However, the entrance on First Avenue will be exposed to the winds coming down First Avenue and thus may be comfortable for only short periods of exposure. Likewise, the entrance at the south end of the 135-foot high Hotel tower may experience a similar level of winds. A slight acceleration of the wind may occur in the narrow gap between the Hotel and the Aquarium. Most of the Harborwalk at the eastern end of the Navy Yard and the Yard's End Park will be in the lee of the Hotel for southwest winds and thus should be quite pleasant and comfortable in the summer. However, it should be borne in mind that, on hot summer days, some windiness may be desirable. Some increased windiness may be caused in the open space between the Hotel and the Rowhouses due to deflection of southwest winds down the 92-foot westerly wing, but the velocity of these winds should be substantially reduced by the 30-foot base.

Easterly (storm) Winds - The entrance to the Hotel on First Avenue will experience some windiness for northeast and east winds but will be sheltered for southeast winds. The entrance from the Harborwalk at the southeast end of the 135-foot tower also will be windy for northeast and east winds but less windy for southeast winds. The main entrance, because it is under the 30-foot extension to the 135-foot high wing, will be protected from all of the easterly winds. The Aquarium will provide some protection to the Hotel from easterly winds, but for both northeast and southeast winds there will be an area of accelerated flow in the narrow passage between the Hotel and the Aquarium. Also northeast winds may be deflected from the 135-foot high wing of the Hotel into

the Yard's End Park, but the accelerated flow would be broken by the 30-foot extension at the end of the building.

Shadows -

The Charlestown Navy Yard redevelopment, and specifically the Hotel, will have minimal negative shadow impacts on proposed active pedestrian open space areas. A shadow analysis undertaken by Sasaki Associates, Inc. and presented in Appendix B indicates the areas where some net new shadow will be cast by the Hotel.

Shadows were projected for the Hotel on four key days of the year (March 21, June 21, September 21, and December 21) to establish a representative view of shadow impacts through the four seasons. Morning (9 AM), noon (12 PM), and afternoon (3 PM) shadows were calculated in order to understand the movement of shadows throughout each key day.

First Avenue - The Hotel will cast shadows on First Avenue during the morning and early afternoon hours during all four seasons of the year. Only in the winter will there remain some shadows on the southerly sidewalk of First Avenue in mid-afternoon.

Yard's End Park - Only in the winter months at mid-day will the Hotel cast a shadow on Yard's End Park. At this season, the Park generally would not be heavily used.

Aquarium Plaza - The entry plaza to the Aquarium will be in partial to full shadow by mid-afternoon during March, September, and December. No shadows will be cast in this area in the summer until late afternoon.

Hotel Entrance Plaza - The plaza area between the main entrance to the Hotel and the Aquarium will be in shadow from the Hotel from late morning on during March, September, and December, but only after early afternoon in June, when shading could be very desirable.

Harborwalk - Very little shadow falls onto the Harborwalk from the Hotel. The Hotel will begin to cast shadows on Harborwalk only after mid-afternoon during all four seasons.

Other Conditions of the Ground-Level Pedestrian Environment -

The proposed hotel on Parcel 4 will have no adverse impact on other conditions of the ground-level pedestrian environment, including visual access considerations. As described in detail in the Mitigation section below, the original plan for Parcel 4 was modified to delete the proposed development of luxury condominium units, improving both physical and visual access to the waterfront and avoiding the privatization of this portion of the waterfront. In addition, the design of the hotel was modified, in consultation with the Massachusetts Historical Commission, the Boston Landmarks

Commission, and the Advisory Council on Historical Preservation, resulting in the predominant massing of the hotel being moved to the north side of the site and away from the waterfront, thus improving both visual access and public accessibility.

Mitigation Measures to be Taken by the BRA

The BRA has taken or proposes the following mitigation measures to avoid or minimize the minimal environmental impacts associated with the construction of the Hotel.

Wind -

The wind assessment indicates that, while there are expected to be some minor increases in windiness from the Hotel for both northwest (winter) and easterly (storm) winds when the Hotel is constructed, particularly in the passage between the Hotel and the adjacent Aquarium, no seriously windy areas will be caused by the addition of this building. The main entrance to the Hotel will be located under a 30-foot extension (arcade) to the 135-foot high wing and thus will be protected from all winds. Furthermore, the two high-rise wings of the Hotel are set back from the ground level by 30-foot high podiums, thus mitigating the impact of the winds on the ground-level pedestrian environment. As further mitigation, trees or other landscaping could be planted in the passage between the Hotel and the Aquarium to reduce the minimal increases in wind flow at this location.

Shadows -

The concentration of new development at the northeastern end of the Navy Yard causes shadows generally to be cast away from the major public areas and toward the Little Mystic Channel and the maritime industrial area beyond. This configuration of the buildings reduces shadow impact in the Navy Yard and enhance sunlight in areas of greatest pedestrian activity.

Net new shadows cast by the Hotel will have minimal adverse impact on high activity pedestrian areas in the vicinity of the site. The Hotel will cast shadows on the Yard's End Park only at mid-day during the winter months, when the park generally would not be heavily used, and will not cast any shadow on the Harborwalk until after mid-afternoon during all four seasons. Major shadow impacts will occur on First Avenue during the morning and early afternoon hours and on the plaza area between the main entrance to the Hotel and the Aquarium from late morning on, except during the summer. The setback of the 135-foot wing of the Hotel from Yard's End Park and the Aquarium entrance plaza has mitigated the impact of shadows from the Hotel on these two major pedestrian activity areas.

Other Conditions of the Ground-Level Pedestrian Environment -

As to conditions of the ground level pedestrian environment, including visual access considerations, study indicates that all feasible mitigation measures have been taken by the BRA to avoid or minimize harm to the environment. The design of the hotel has been modified in consultation with the Massachusetts Historical Commission, the Boston Landmarks Commission, and the Advisory Council on Historic Preservation. This process has resulted in the predominant massing of the building originally approved by the Secretary in a "dumbbell" shape, being moved to the northern side of the site.

In addition, thirty townhouse condominiums originally approved for the water's edge have been deleted from the Parcel 4 plan. This deletion results in a continuous Harborwalk, improving both physical and visual access to the waterfront. Through deletion of the townhouses, privatization of this portion of the waterfront is avoided.

The original plan for Parcel 4 called for luxury condominium units. By moving the hotel to this site, greater opportunities for uses conducive to a welcoming ground level pedestrian environment are provided. Entrances and lobbies will be open off of First Avenue, Harborwalk, and the Sixteenth Street extension (facing the Aquarium) to permit pedestrian through circulation to and from the waterfront. The hotel will also include dining facilities open to the public, in addition to being open to the public itself. The open spaces surrounding the hotel will be landscaped and maintained to promote public accessibility, in contrast to the earlier "privatized" plan.

Section 61 Finding

The BRA has carefully considered these three areas of environmental impact and identified all feasible means and measures for avoiding or minimizing these impacts. Mitigation measures will help to ensure that the public's right to waterfront access will be enhanced, and that sunlight and other important conditions of the ground-level pedestrian environment will be protected.

Other environmental impacts have been adequately evaluated in previous MEPA filings, as determined by the Secretary in his decision of January 2, 1991.

Therefore, pursuant to M.G.L. Ch. 30, Section 61, it is hereby found and determined that the proposed development of the Charlestown Navy Yard Hotel will not result in significant damage to the environment and, further, that all feasible means and measures for avoiding or minimizing adverse environmental impacts have been or will be taken.

BOSTON REDEVELOPMENT AUTHORITY

By: _____

Date: _____

APPENDIX A

AN ASSESSMENT OF PEDESTRIAN LEVEL WALKS FOR THE PROPOSED HOTEL

AN ASSESSMENT OF PEDESTRIAN LEVEL WINDS
FOR THE PROPOSED PARCEL 4 HOTEL
IN THE CHARLESTOWN NAVY YARD, BOSTON, MASSACHUSETTS

AUGUST 31, 1991

ADAPTED FROM A STUDY BY FRANK H. DUNCAN P.E.

APPENDIX A

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IN THE CHARLESTOWN NAVY YARD, BOSTON, MASSACHUSETTS

AUGUST 21, 1991

ADAPTED FROM A STUDY BY FRANK H. DURGIN P.E.

- a) Charlestown Navy Yard Master Plan dated June 1986
- b) A similar drawing illustrating wind direction and intensity of windings at an interior site
- c) Three drawings showing N, E, S, and W directions and windward and leeward buildings including north arrow and scale bar August 1991 dated November 1991
- d) The Charlestown Navy Yard - Parcel 4 and Parcel 5 Master Plan dated December 2, 1987 prepared by Francis Brinkman, Carter and Vaughan dated December 2, 1987
- e) City of Boston Zoning Map and Planning Map No. 140-25, May 1981
- f) Air quality zoning map showing height of the Charlestown Navy Yard building
- g) Elevations and floor levels of buildings 25, 26, 27, 28, 29, 30, and 31 and the surrounding area including the surrounding area including the surrounding area
- h) Section, Ground Floor Plan and Airflow Plan for Parcel 4, 5, and 6 of the Charlestown Navy Yard dated May 3, 1990 and submitted by Dan Klaber, July 10, 1991
- i) Three 1/2 by 11 Spirit drawings showing the entrance to all buildings at interior

2) Two site visits during which 25 photographs were taken of the buildings on the site and in the site's surroundings

3) An evaluation of the urban climate of the proposed project

4) A review of wind climate data for local area

5) Frank Durgin's 22 years of experience dealing with pedestrian level winds

The interaction of the wind with buildings and structures is a very complex and is not fully understood. This has evaluation can be treated as a qualitative assessment of pedestrian level winds.

AN ASSESSMENT OF PEDESTRIAN LEVEL WINDS

FOR THE PROPOSED PARCEL 4 HOTEL

IN THE CHARLESTOWN NAVY YARD, BOSTON, MASSACHUSETTS

1 INTRODUCTION

1.1 BASIS

This evaluation of pedestrian level winds is based on:

- 1) The drawings listed below received from Jonathan Warner of Sasaki Associates:
 - a) Charlestown Navy Yard Master Plan dated June 1991;
 - b) A similar drawing (unnamed and no date) with isometrics of buildings at an interim stage;
 - c) Three drawings containing N, E, S, and W elevations and transverse and longitudinal sections for the new New England Aquarium dated November, 1989;
 - d) The Boston Navy Yard - Charlestown, Land Parcel Plan Alternate 2, prepared by Parsons, Brinkerhoff, Quade, and Douglas, dated November 5, 1976;
 - e) City of Boston Topographic and Planimetric Map No. 19N-13E, rev. 1988;
 - f) Map giving Existing Building Heights for the Charlestown Navy Yard (no date);
 - g) Elevations and Plan views for Buildings 75, 105, 106, 114, 199, 266, and for the Rowhouses on Thirteenth Street (various dates and sources);
 - h) Section, Ground Floor Plan, and Atrium Floor Plan for Phases A, B, and C of the Biomedical Research Center dated May 21, 1991 and annotated by Don Klabin, July 10, 1991;
 - i) Three 8.5 by 11 figures showing the entrances to all buildings of interest.
- 2) Two site visits during which 28 photographs were taken of the buildings on the site and in the site's surroundings;
- 3) An evaluation of the urban context of the proposed project;
- 4) A review of wind climate data for Boston; and
- 6) Frank Durgin's 22 years of experience dealing with pedestrian level winds.

The interaction of the wind with buildings and structures is very complicated and, at times, unpredictable. Thus, this evaluation must be treated as a qualitative assessment of pedestrian level winds.

1.2 LOCATION AND DESCRIPTION OF THE PROJECT

The site of the proposed Parcel 4 Hotel is at the east end of the Charlestown Navy Yard southeast of Buildings 199, 75, 106, and also northeast of the existing set of Rowhouses.

Figure 3 depicts the configuration of the site that is considered to be the build condition for the assessment. Building A of the Biomedical Research Center is assumed to exist. The ell that currently runs southwest at the north end of Building 114 has been removed to allow Sixteenth Street to be extended to Chelsea Street, and a 98 foot addition has been added at the south end of Building 114, extending it to the edge of the Little Mystic Channel. The currently existing Buildings 218A, 210, 178, 193, 203, 131, 165, and 226, all shown in the Land Parcel Plan, Alternate 2, are assumed razed and not replaced. Buildings 77, 104, 187, 214, 206, and 215c, also shown on the Alternate 2 plan, have already been razed.

Building numbers are given in Figure 3. For this wind assessment it is important to know the relative heights of all the buildings. They are listed below:

Building	Roof Edge hgt (feet)	Total hgt (feet)
P	27	35
75	15	27
106	42	59
114	48	48
199	108	108
266	31	40
Rowhouses	23	30
	50	75
Hotel	135	148
	105	115
	75	92
	30	30
Building A	140	140
Atrium		140

The discussion in this report will be restricted to those areas that pedestrians will be expected to use. Thus wind conditions at all building entrances and the approaches to them along the Harborwalk in the Yard's End Park will be covered.

1.3 DESCRIPTION OF THE AREA SURROUNDING THE PROJECT

This is a very exposed site. The Little Mystic Channel runs east-west just north of the site, and the Mystic River and Inner Boston Harbor lie to the east and south. Only to the west and the southwest are there significant buildings. Most are 30-50 feet high, but there are a couple of exceptions: Building 149, about the same height as 199, lies to the southwest, just across Thirteenth Street from Building 199; Building 197 at about 120 feet building in height lies a little more to the south and about 1400 feet away. Downtown Boston, including the Financial District with it many 25-40 story buildings, lies across the Boston Inner Harbor about 1.75 miles SSW of the site.

2. THE WIND CLIMATE

2.1 VARIATION OF AVERAGE VELOCITY WITH HEIGHT

In general, the natural wind is unsteady (i.e., it is gusty) and its average velocity increases with height above the ground. Figure 5 depicts approximately how the average velocity varies with height for different types of terrains. Although generally it does not happen, when one puts up any building the possibility exists that the building will bring the higher speed winds at the top of the building down to ground level.

Monolithic buildings (i.e., those that do not change shape with height), if they are significantly taller than most of surrounding buildings, almost invariably will be windy at their bases. However, when there are many buildings of similar height in an area, the buildings tend to shelter one another.

2.2 STATISTICAL DESCRIPTION OF WIND

The site is about 1.75 miles from downtown Boston and about 2.25 miles west of Logan Airport. Thus the wind data from Logan Airport typically used to define winds for Boston are applicable. Figure 6 depicts a wind rose for Boston. As noted in the figure, the windrose is based on surface wind data from Logan Airport taken from 1945 to 1965. The length of each line radiating from the center of the figure to the outermost crossing line is proportional to the total time the wind comes from that direction. The other lines crossing the radial lines are winds less than 3, 12, and 25 mph.

Figure 6 shows that the winds in Boston come primarily from the NW, W, and SW. Figures 7-10 show wind roses for Boston for winter (Dec., Jan., and Feb.), spring (Mar., Apr., and May), summer (Jun., Jul., and Aug.), and fall (Sep., Oct., and Nov.). These figures show that NW winds tend to occur in the winter and SW winds in the summer. Spring and fall are transitional, but winds are stronger in the spring than in the fall. Strong easterly winds usually occur during storms when there is precipitation. Northwest winds blow across the Mystic Tobin Bridge and straight down Thirteenth and Sixteenth Streets. Southwest winds blow up First, Third, and Fifth Avenues. The effect of these winds as well as easterly storm winds is discussed below separately.

The average wind speed at Logan Airport at 58 feet (the average height at which the data were taken) is 12.9 mph. At pedestrian level (i.e. chest height, 4.5 feet), it is about 8 mph. The average wind speed at 58 feet at Logan Airport for each month is shown in Figure 11. Seasonally, the average is 14.2 mph in the winter, 13.9 mph in the spring, 11.2 mph in the summer, and 12.3 mph in the fall. However, the fastest hourly wind for a 100 hour return period is slightly faster in the spring than in winter.

3. CRITERIA

Since the early 1980's, Boston has used the guideline criterion for acceptable winds of not exceeding a 31 mph effective gust more often than once in 100 hours. The effective gust is defined as the average plus 1.5 times the root mean square variation about the average (rms).

In 1978, Melbourne developed probabilistic criteria for pedestrian level winds which account for different types of pedestrian activity as well as safety aspects of such winds (see Figure 12). He defined five categories for pedestrian level winds:

- 1) Dangerous and Unacceptable.
- 2) Uncomfortable for Walking.
- 3) Comfortable for Walking.
- 4) Comfortable for Short Periods of Standing or Sitting.
- 5) Comfortable for Long Periods of Standing or Sitting.

These criteria are not absolute (any location can have dangerous winds in a hurricane); rather they imply that the location would have winds speeds such as that the activity suggested is possible most of the time, and would be perceived as such by most people who are at the location frequently. For example, winds at pedestrian level at Logan Airport are just in the Category 2, uncomfortable for walking, and just under the guideline 31 mph effective gust wind speed.

4.0 PEDESTRIAN WINDS AT THE SITE

4.1 INTRODUCTION

In the following sections, the effects of the NW winter winds, the SW summer winds, and easterly storm winds will be discussed for the Build conditions defined in Figure 3.

For the most part, the weather in New England is dominated by either large coastal storms (fall, winter, and spring) or the Bermuda High (summer). Typically, when a coastal storm occurs, it rains or snows for four to twelve hours, then it clears, and the wind blows from the northwest for three or four days before the next weather system arrives. These storms, and the northwest winds following them, occur mostly in the fall, winter, and spring. Northwest winds are particularly uncomfortable in the winter, when typically they occur on cold days. The Bermuda High is responsible for the southwest winds that occur in the summer.

4.2 NW (WINTER) WINDS (FIGURE 13)

As previously noted, NW winds blow across the Mystic Tobin Bridge and directly down Thirteenth and Sixteenth Streets. They can be very uncomfortable on a cold winter day.

Currently, accelerated NW winds probably occur under the pedestrian overpasses at the corner of Thirteenth Street and Third Avenue (see Figure 13). The main pedestrian entrances to both Buildings 199 and 149 are under these overpasses. Normally one would expect the winds there to be high in Category 3 or low in Category 2. But the Mystic Tobin Bridge is about the same height as Building 199 in that area and probably significantly reduces the NW winds coming at the upper stories of Building 199. As a result, winds at those entrances are probably no worse than high in Category 3.

The removal of the ell on Building 114 to allow Sixteenth Street to be extended to intersect Chelsea Street opens Sixteenth Street up to NW winds coming under the Mystic Tobin Bridge. The removal of Building 217 opens the gap further. The addition of the 98 foot high ell on the east side at the south end of Building 114 brings that end of Building 114 out to the edge of the Little Mystic Channel and to a height only 40 foot less than Building A of the Biomedical Research Center (Figure 3). Thus, it is to be expected that there will be significant acceleration of NW winds in Sixteenth Street between Buildings 199 and 114 as well as between Building 199 and Building A of the Biomedical Center. This will be especially true under the pedestrian overpass between Building 199 and Building A where it seems likely winds would be high in Melbourne Category 3.

Normally Sixteenth Street between Building 199 and Building 114 would be windy now, since Building 199 is twice as tall as any of the upwind buildings. That is, one would expect the higher winds to be brought down from the top of Buildings 199. But with the Mystic Tobin Bridge upstream, the winds at both the north and west corners of Building 199 are accelerated, but not as much as without the Mystic Tobin Bridge. It seems likely that the winds at the north corner of Building 199 will be in mid or high Melbourne Category 3, and those at the west end in mid or low Category 3.

The main entrance to Building A in its SE wall will be in the lee of Building A for NW winds and thus probably in Category 4 or 5.

The Harborwalk along the Little Mystic Channel and the Mystic River will probably be high in Melbourne Category 3 due to its very exposed nature (its exposure is similar to that at Logan Airport). However, at its northernmost point, where it rounds the north corner of the 98 foot extension to Building 114, it may be in low Category 2 (Figure 13). Toward the Harborwalk's southern end, particularly near the Rowhouses, it will be less windy (low Category 3), since much of the walk in that area is in the lee of many buildings.

For the same reasons the Yard's End Park will be quite windy (Category 3) for this initial condition, excepting for that part which is in the lee of Building A.

The Hotel has 3 entrances. The one on First Avenue is in the middle of the 30 foot high low part and shielded by both Building 106 across First Avenue and Building 199 further upstream. Winds there will be in Category 4 for NW winds. The second entrance, at the southeast end of a 135 foot building, is in the lee of that building for NW winds and probably in Category 5. The main entrance to the Hotel is under the 30 foot extension to the 135 foot building and thus very protected from all winds. Just to the east of the entrance building winds

would be in Melbourne Category 3, were not that area in the lee of Buildings 199 and A. Actually, wind conditions there will probably be high in Category 4 or low in 3.

4.3 SW (SUMMER) WINDS (FIGURE 15)

The prevailing winds in the summer are from the SW. SW winds approach the site coming directly up First and Fourth Avenues from the southwest end of the Yard. It should be born in mind that, on hot days, some windiness may be desirable.

For SW winds, with the exception of Buildings 149 and 197, all upwind buildings are 2 to 5 stories and act to shield the buildings of similar height on the site (P, 75, 106, 266, and the Rowhouses). Building 149 is the same height as Building 199, and is just across Thirteenth Street and slightly displaced to the southeast. As such, it provides considerable shielding for Building 199. Thus, the south corner of Building 199 is probably never windy for SW winds and the west corner only somewhat windy for the more westerly of these SW winds (Melbourne 3 at most; see Figure 15). At the entrances to Buildings 149 and 199 under the overpass between Buildings 149 and 199 the winds could be low in Category 3.

For SW winds, the corner of Fifth Avenue and Sixteenth Street may be somewhat windy due to Building 114 deflecting the wind SE down Sixteenth Street (Category 4). However, probably there will be a strong squirt of wind up the alleyway between Buildings 114 and A (Category 3; see Figure 15).

SW winds will cause accelerated flow around the south corner of Building A as shown in Figure 15 (Category 3). But these winds probably will not affect the main entrance to Building A, so that winds there will be in Category 4 or 5.

Most of the Harborwalk and the Yard's End Park are always in the lee of Navy Yard buildings for SW winds and thus the entire Harborwalk will be quite pleasant in the summer (probably in Melbourne 4 or 5). However, where Harborwalk passes the small tower at the SE end of the Rowhouses there may be some windiness (Melbourne 3).

Also, because the tower at the NW end of the Rowhouses is considerably taller than any of the buildings upwind of it, for SW winds its west corner may be a little windy (Melbourne 3).

Finally, the main entrance to the Hotel will be in the lee of the Hotel and thus very calm (Category 4). However, the entrance on First Avenue will be exposed to the winds coming down First Avenue (Category 4). Similarly, the entrance at the south end of the 135 foot high Hotel tower may be a little windy (Category 3 or 4).

4.4 STORM (EASTERLY) WINDS (FIGURES 17, 19, AND 21)

Easterly winds occur about one third of the time. Light easterly winds occur as a storm first starts or, in the summer, as a sea breeze. During the first 4-12 hours of a typical coastal storm, it rains or snows depending on the temperature, and the wind is generally from the NE or SE depending on whether the center of the storm passes to the E or W of the city.

Strong easterly winds, generally occur when it is snowing or raining. Thus, the emphasis in the following discussion will be on entering or exiting the various buildings.

For NE, E, and SE winds there will be some accelerated flow at the entrances to Buildings 149 and 199 under the pedestrian overpasses on Thirteenth Street. SE winds will cause the worst conditions (high Category 3). SE winds will also cause a squirt of wind around the east corner of Building 149 into Thirteenth Street, toward the entrances under the pedestrian overpasses (see figure 21).

Sixteenth Street between Buildings 199 and 114 and between Building 199 and Building A of the Biomedical Center will be in the lee of Buildings 116 and A for NE and E winds, but will experience accelerated flows for SE winds. Thus the entrance to Building A under the pedestrian overpass will probably be quite windy (Category 3) for SE winds.

The main entrance to Building A at its SE end will be particularly windy for both NE and E winds (high Category 3 and possibly low 2), but not as windy for SE winds. It would appear that for most storms one of the two entrances to Building A probably would be protected for the existing conditions.

Most of the Harborwalk will be in high Category 3 or low 2 for all these easterly winds. However, the Harborwalk near one of the two north corners of the 98 foot high extension to Building 114 will experience winds that probably exceed the BRA guideline 31 mph effective gust wind speed. While not as great, the flow in the Harborwalk near the tower at the southeast end of the Rowhouses will also be accelerated for these winds (high Category 3).

The entrance to the Hotel on First Avenue will experience some windiness (low Category 3) for NE and E winds, but will be sheltered for SE winds. The entrance to the Harborwalk at the southeast of the 135 foot tower will also be windy for NE and E winds (High Category 3), but less windy for SE winds. The main entrance, because it is under the 30 foot extension to the 135 foot tower, will be protected from all of these easterly winds.

5. SUMMARY

An assessment of the effect of adding the Parcel 4 Hotel to the Charlestown Navy Yard complex has been made. The assessment conditions for build conditions are depicted in Figure 1. Winds at the entrances to the Hotel are acceptable for most wind directions.

Expected wind conditions at the main entrances to Buildings A, B, and C of the Biomedical Research Center are expected to be acceptable. Those at the Entrance to Building A are much improved. Wind conditions at the main entrance to the Aquarium are also acceptable for all winds.

Wind conditions in Yard End Park at the SE where most pedestrian traffic is expected and along other pedestrian pathways remain relatively unaffected under build conditions.

However, First Avenue will be slightly worsened by the corridor effect of the Parcel 4 Hotel under some wind conditions, notably storm conditions. While wind conditions over the rest of Harborwalk will still be windy at times, this is a result of the exposed nature of the Harborwalk.

6. MITIGATION

Any worsening of wind conditions caused by the Parcel 4 Hotel will be lessened under the proposed Full Build conditions in the future. Temporary screens such as tree and shrub plantings or a screen wall could be erected in the interim. Awnings, street trees, and pedestrian arcades and other variations in the Hotel's facade plane will also serve to lessen any wind impacts.

Figure 1

Charlestown Navy Yard
Parcel 4 Hotel
Build Conditions

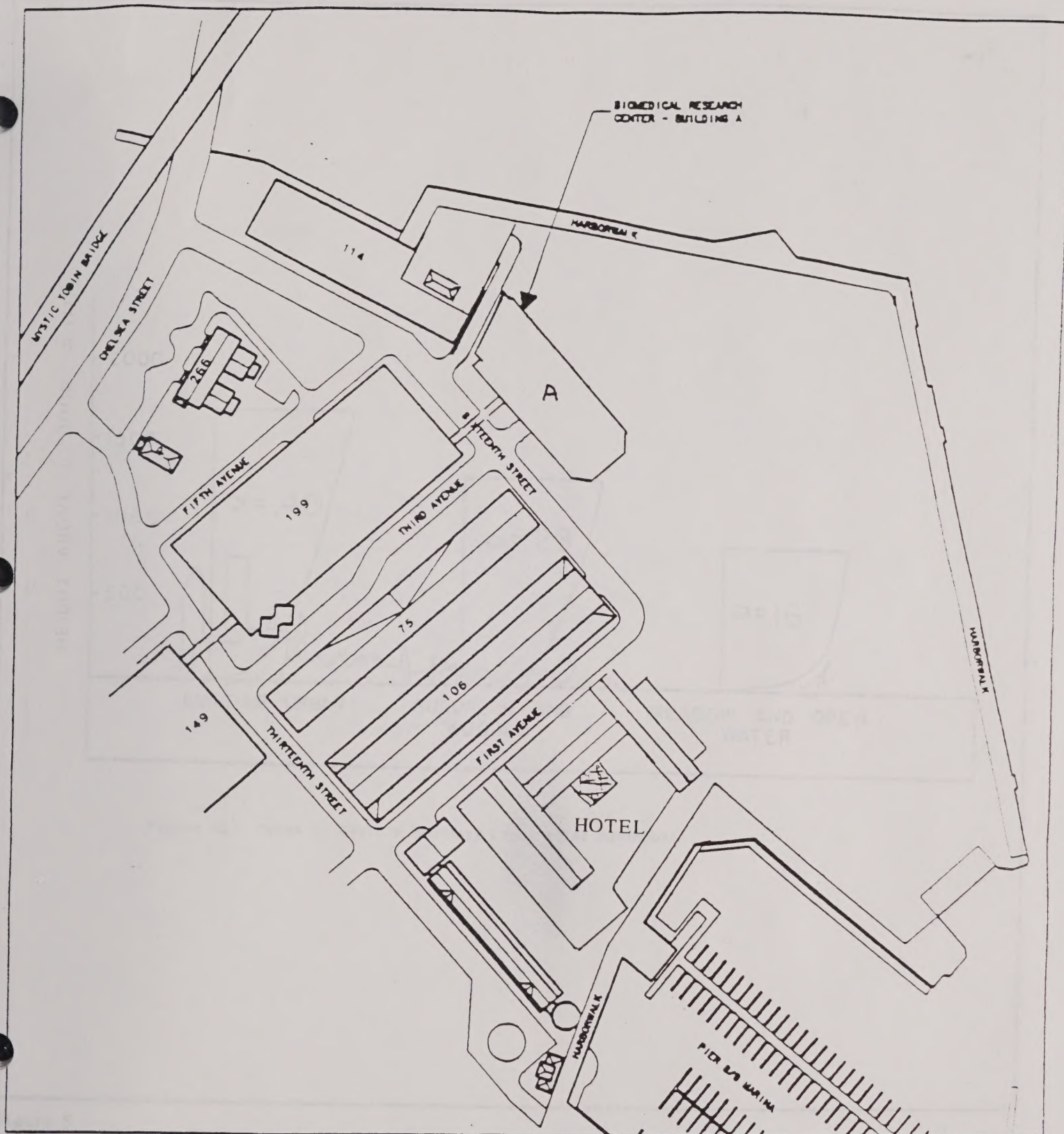


Figure 3

Charlestown Navy Yard
Parcel 4 Hotel

Build Conditions



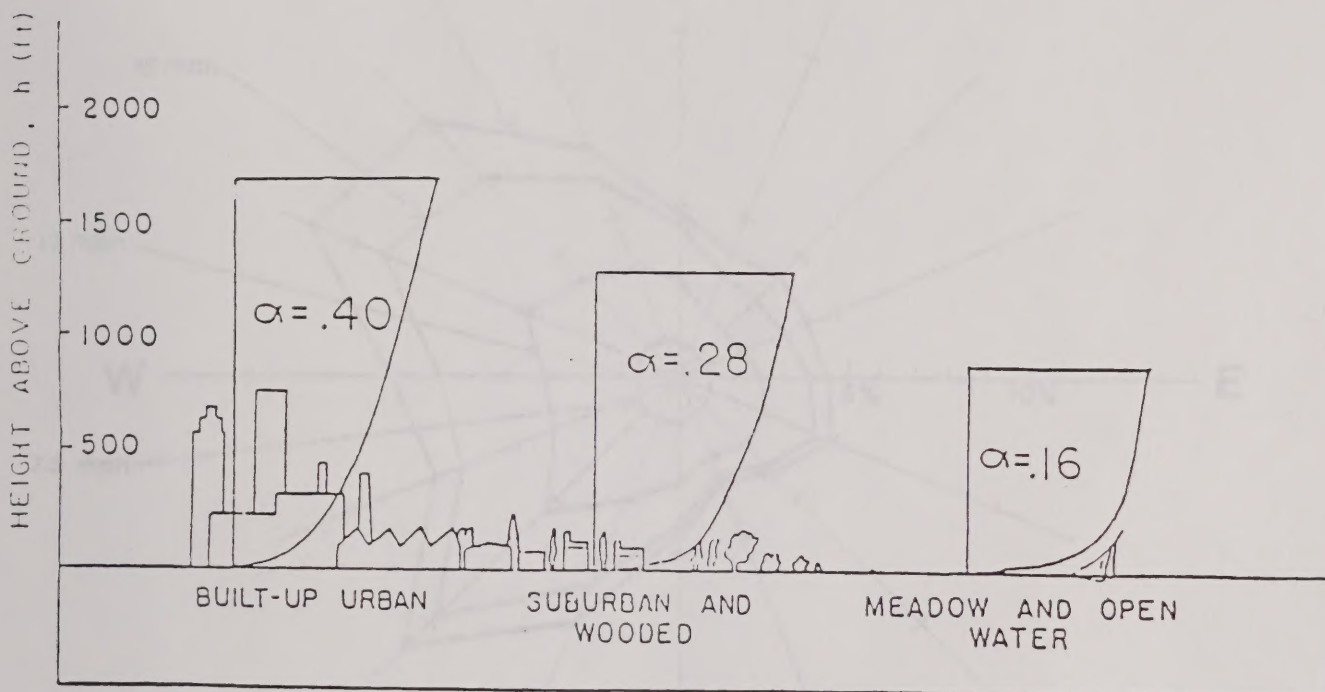


Figure A1. Types of Earth's Boundary Layer after Davenport

Figure 5

Types Of Earth's Boundary Layer After Davenport

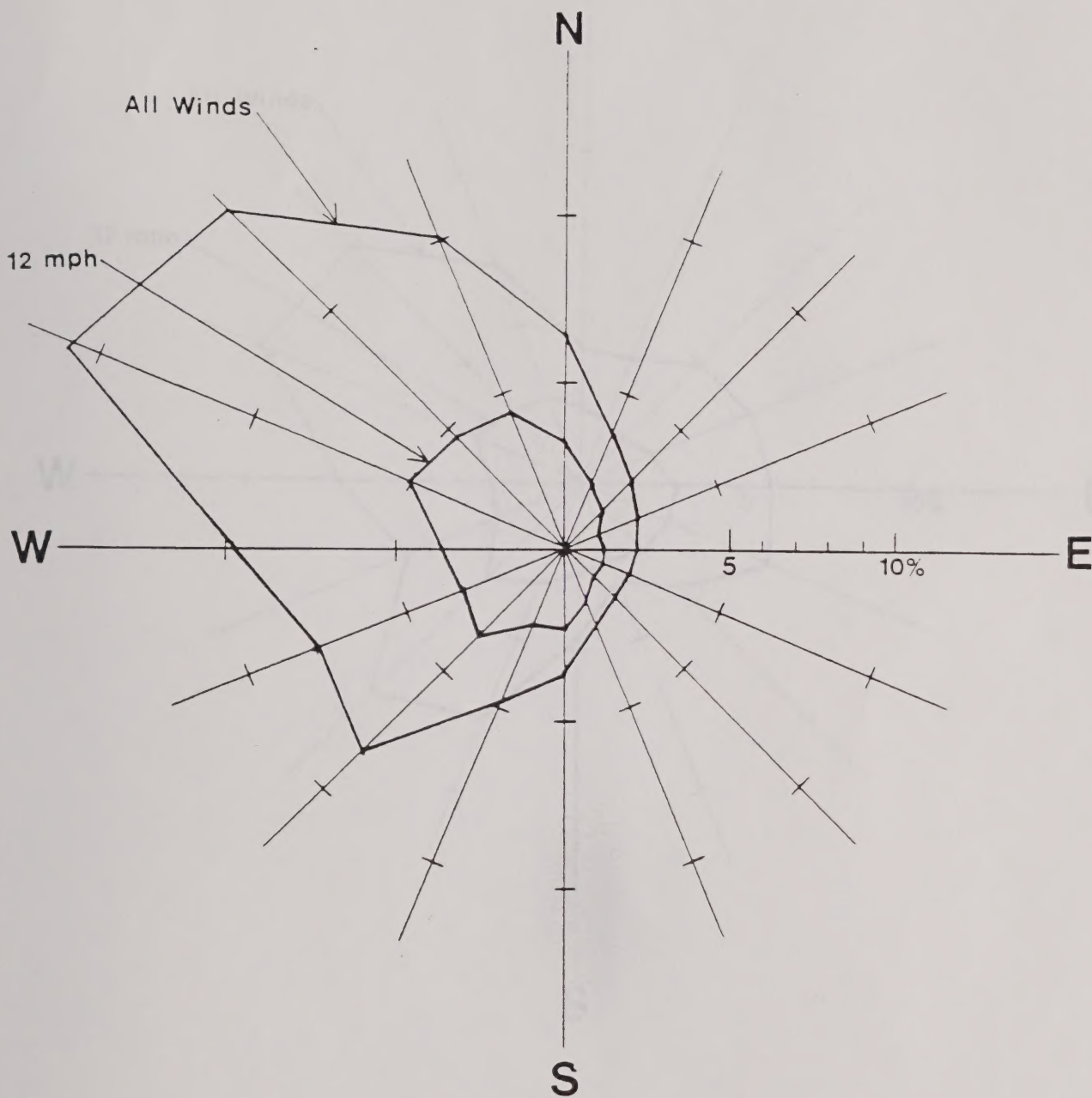


Figure 7

Boston Wind Rose For The Winter (December, January, February)

Surface Data Obtained From Logan Airport 1945-1965

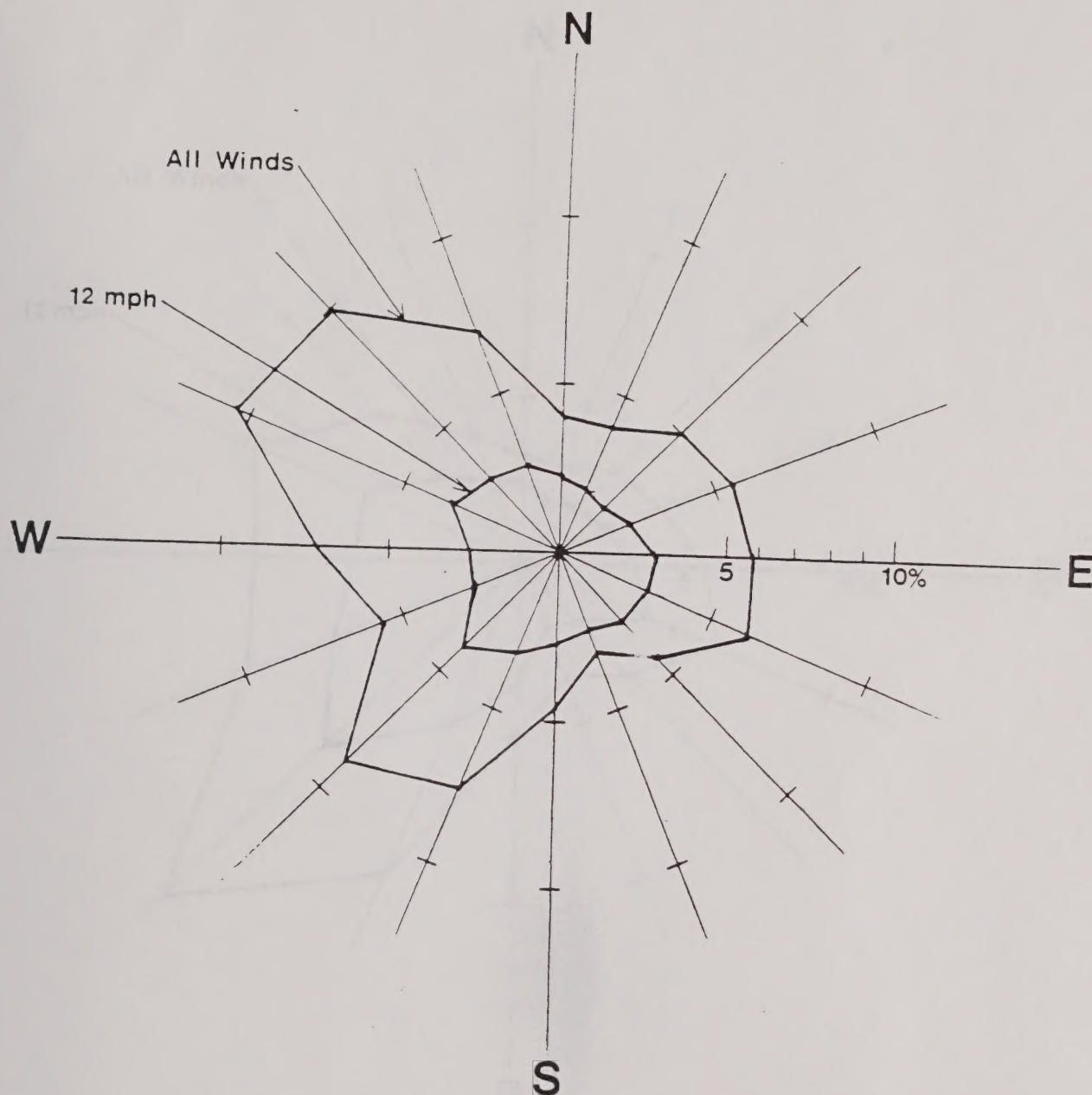


Figure 8

Boston Wind Rose For The Spring (March, April, May)

Surface Data Obtained From Logan Airport 1945-1965

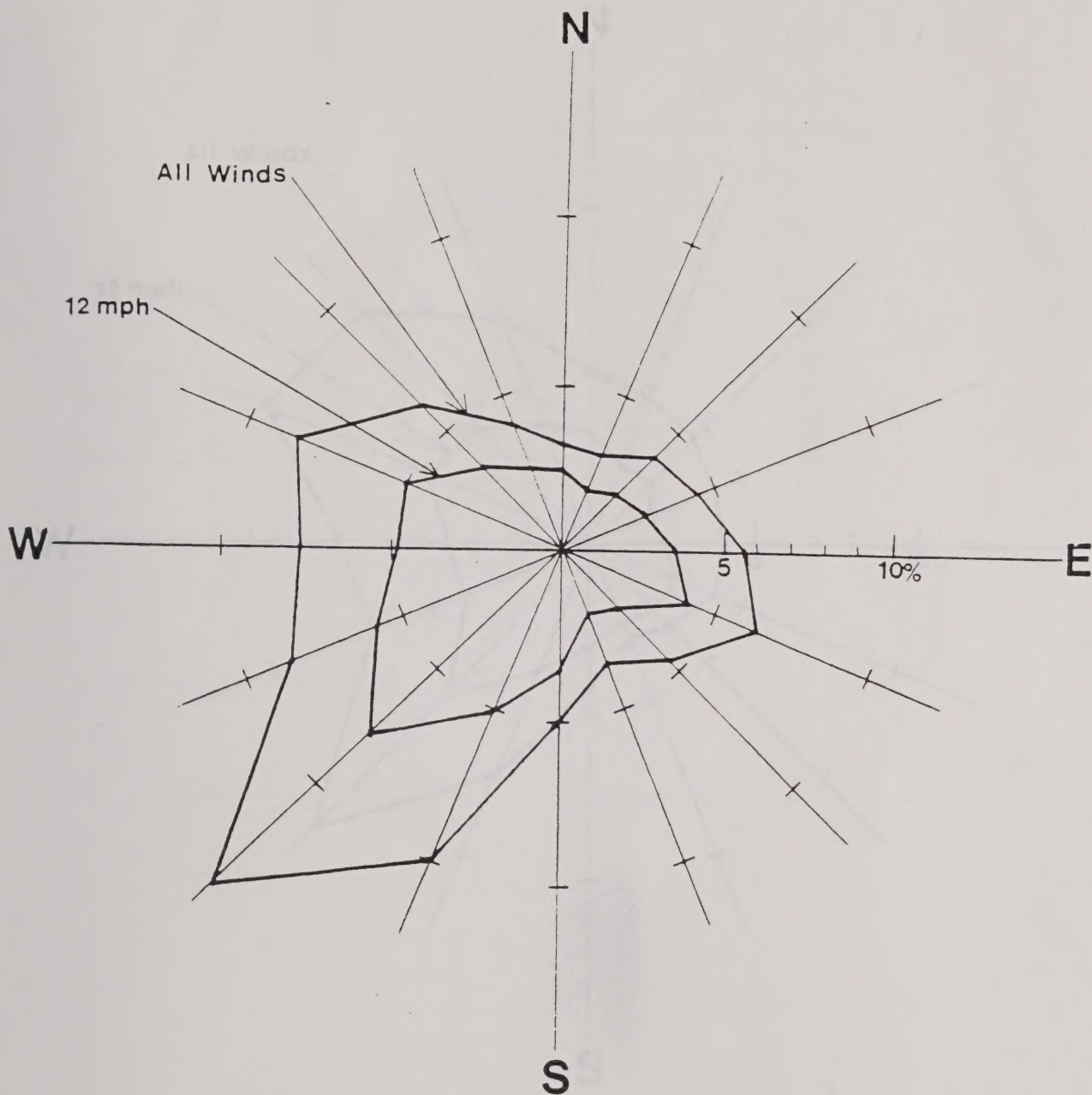


Figure 9

Boston Wind Rose For The Summer (June, July, August)

Surface Data Obtained From Logan Airport 1945-1965

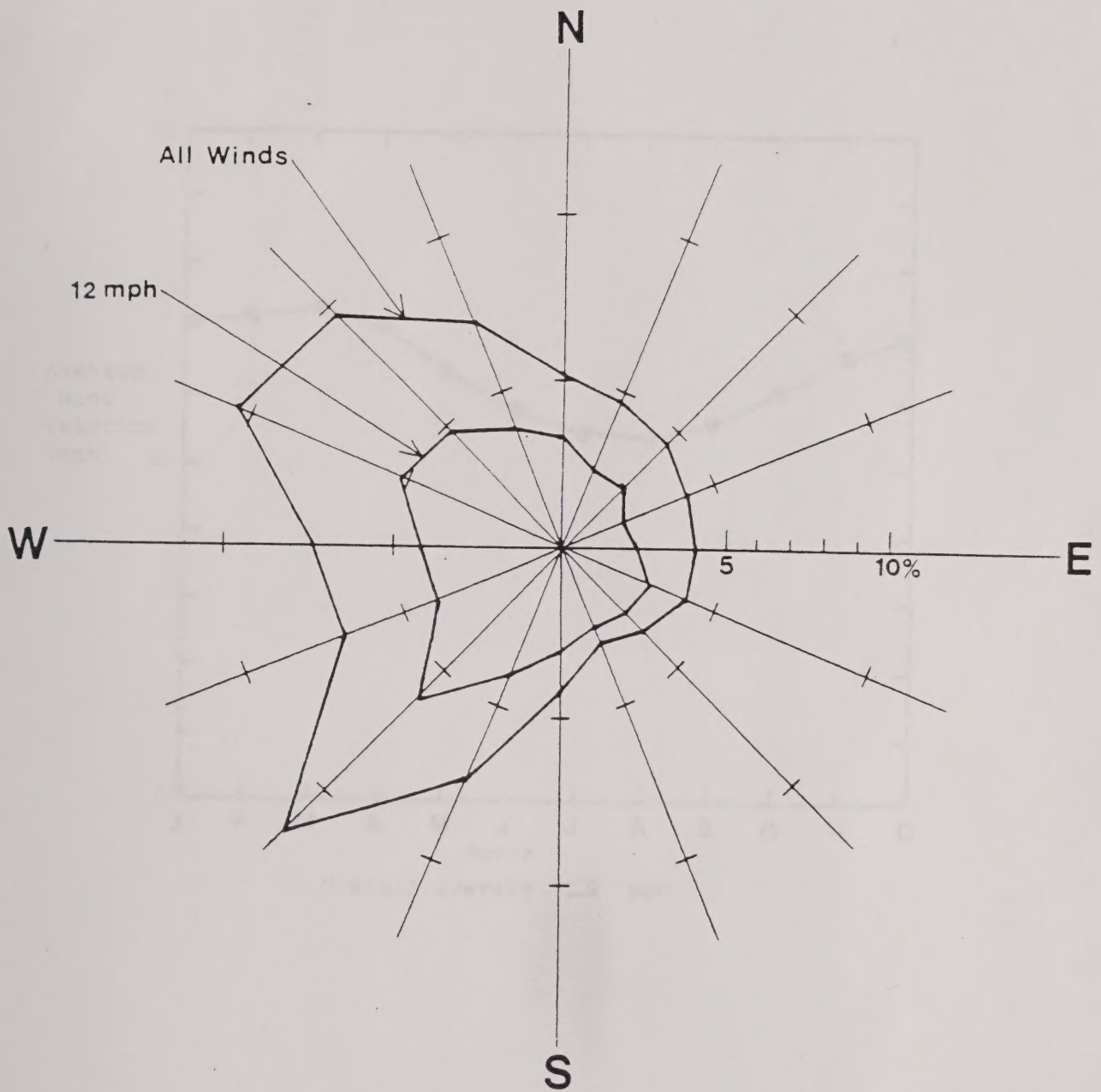


Figure 10

Boston Wind Rose For The Fall (September, October, November)

Surface Data Obtained From Logan Airport 1945-1965

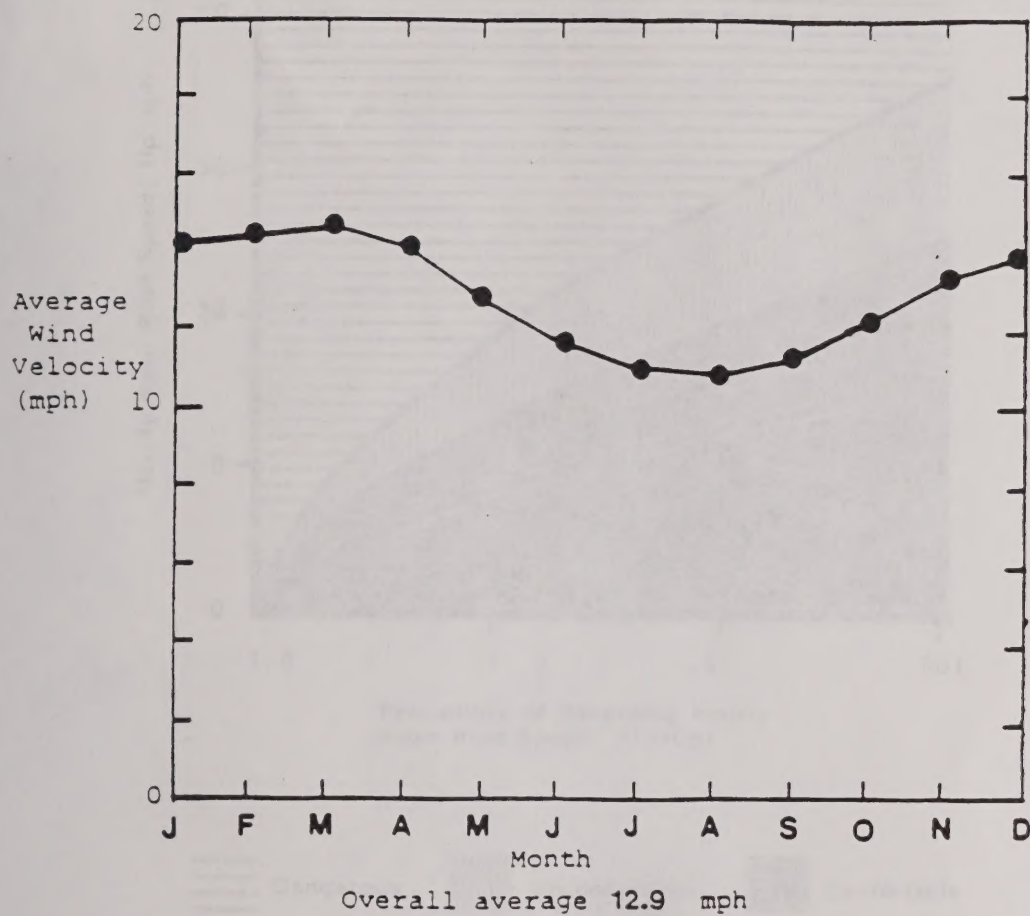
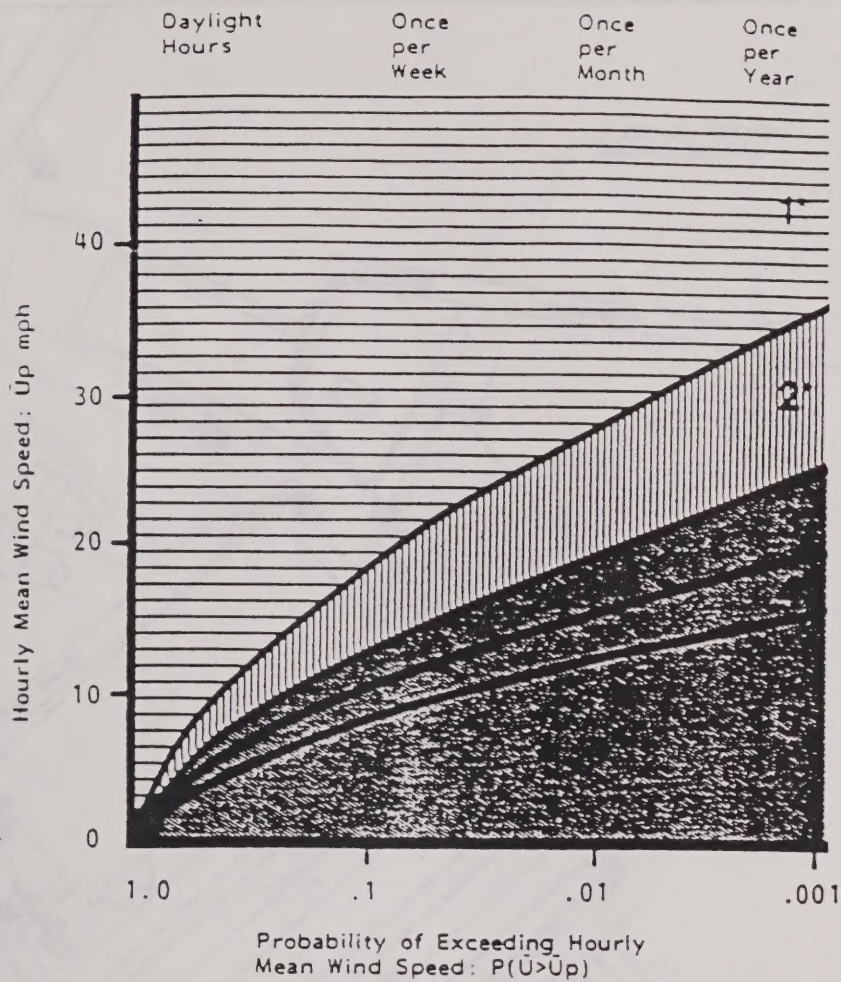


Figure 11

Average Wind Velocity At Logan Airport At 58 ft 1945-1965 By Month



Dangerous
 Uncomfortable
 Comfortable

* Melbourne's Category

- 1 Unacceptable and dangerous
- 2 Uncomfortable for walking
- 3 Acceptable for walking
- 4 Acceptable for short periods of standing or sitting
- 5 Acceptable for long periods of standing or sitting

Figure 12

Melbourne's Category

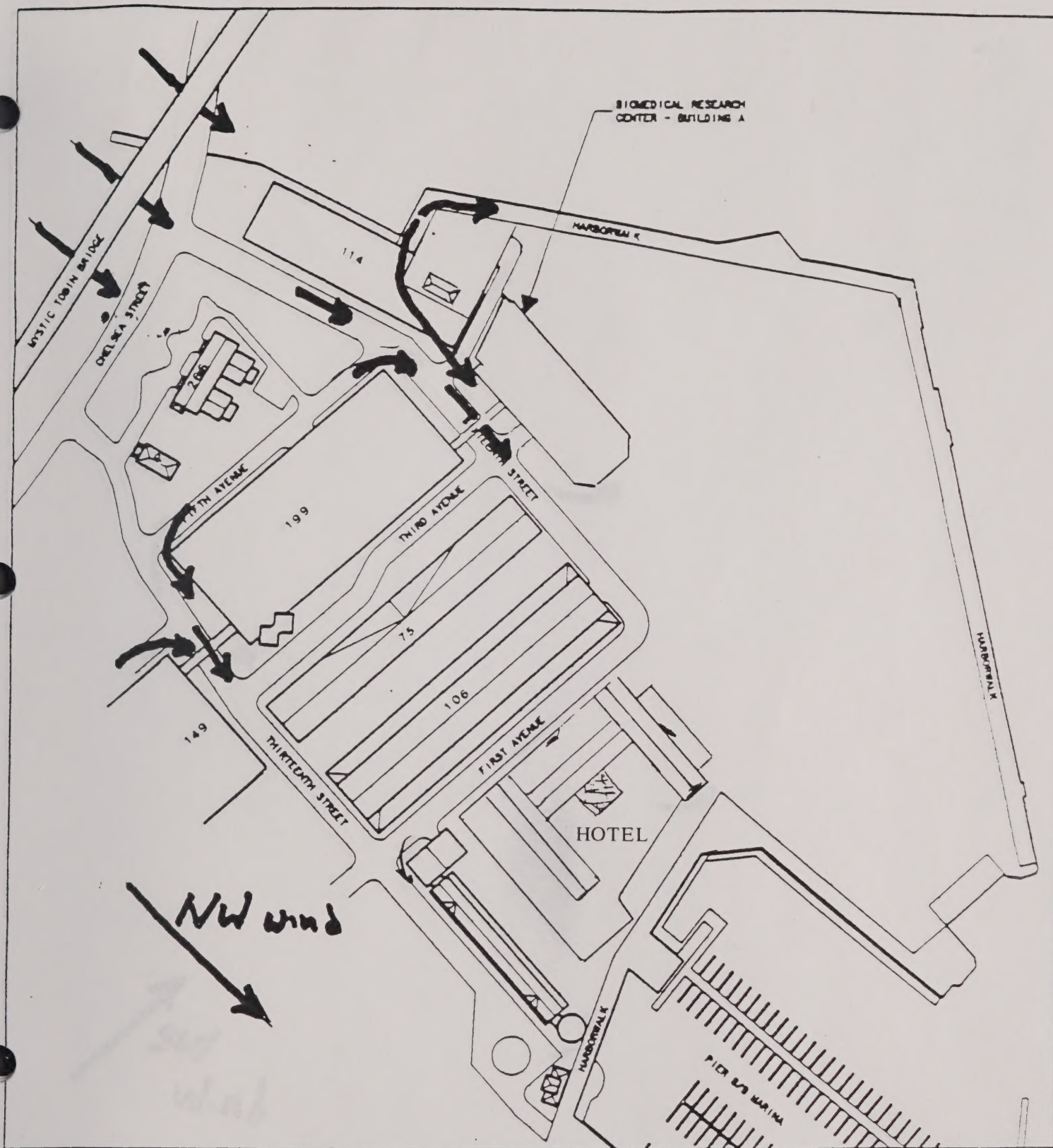


Figure 13

Charlestown Navy Yard
Parcel 4 Hotel
Build Conditions - NW Wind



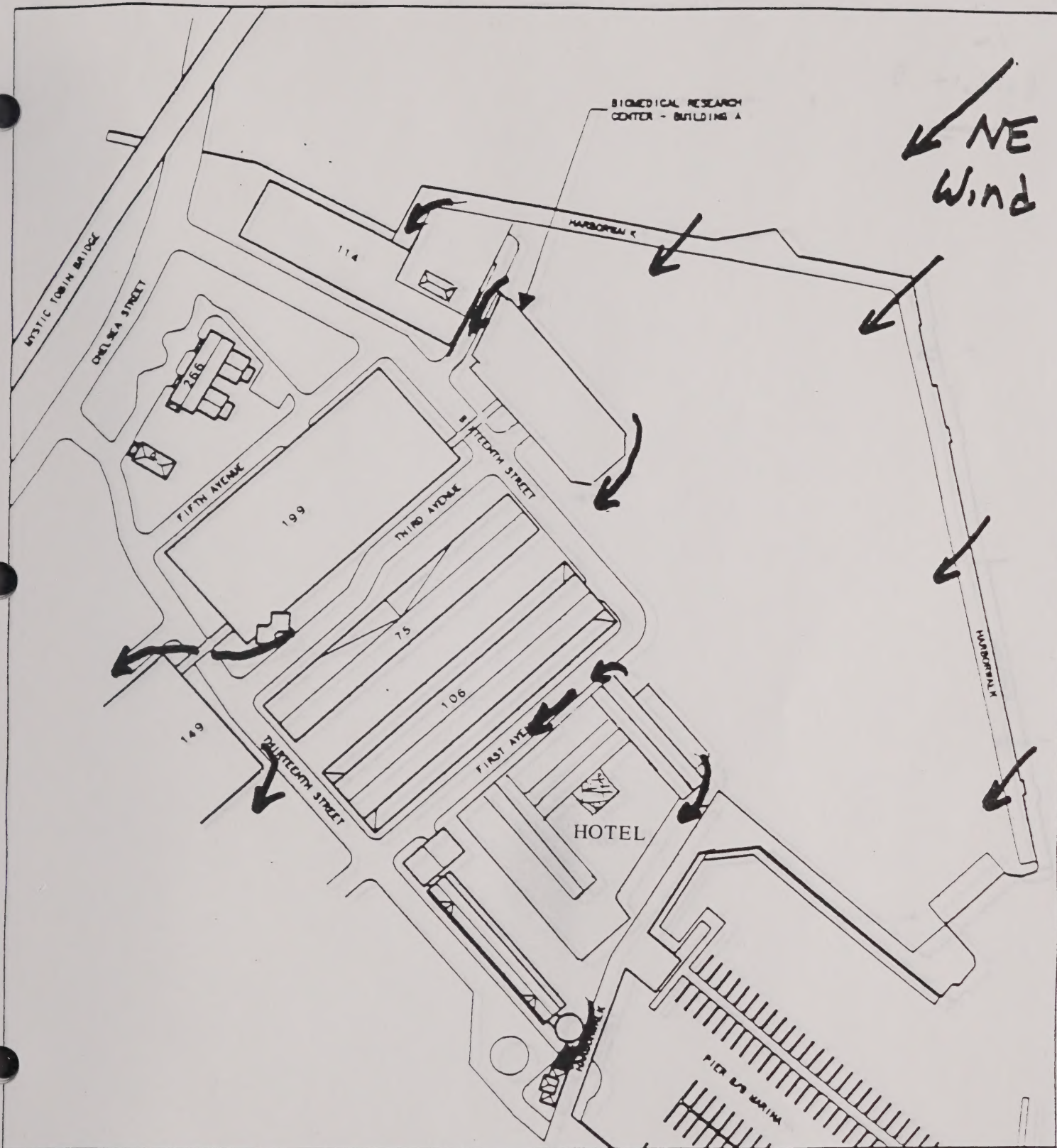


Figure 17

Charlestown Navy Yard
Parcel 4 Hotel
Build Conditions - NE Wind



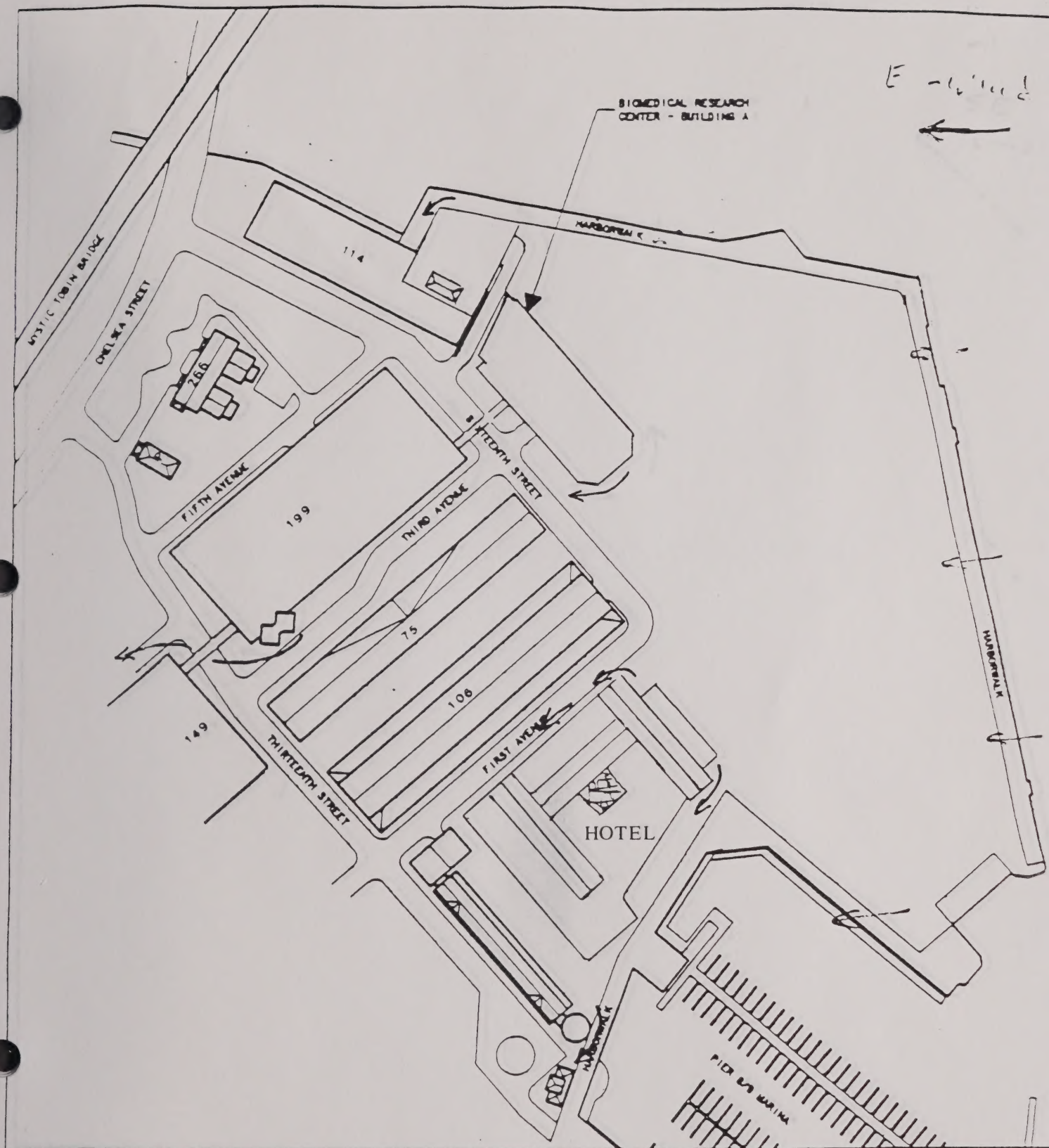


Figure 19

Charlestown Navy Yard
Parcel 4 Hotel
Build Conditions - E Wind

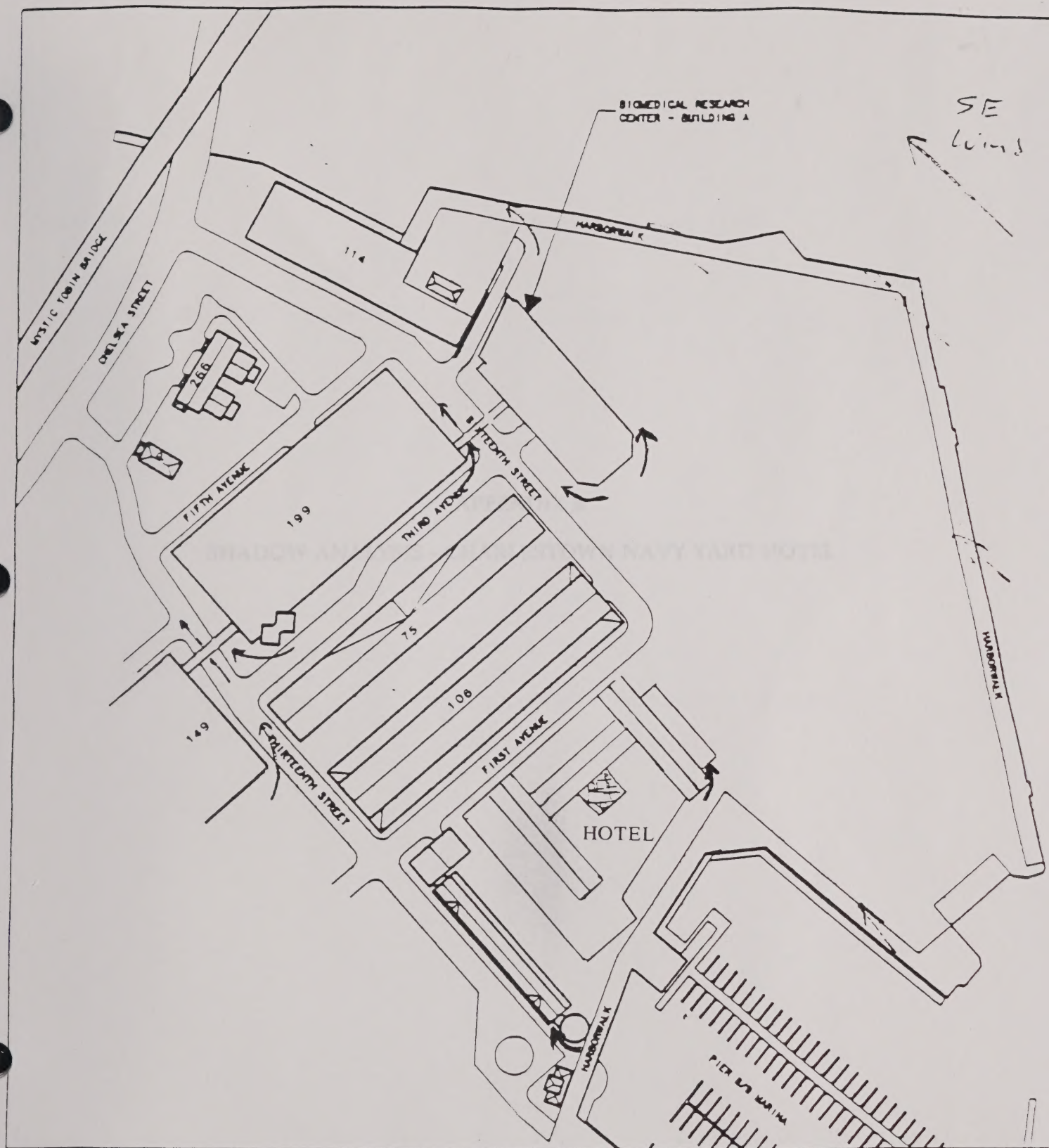


Figure 21

Charlestown Navy Yard
Parcel 4 Hotel
Build Conditions - SE Wind

APPENDIX B

SHADOW ANALYSIS - CHARLESTOWN NAVY YARD HOTEL

Sasaki Associates, Inc.

CHARLESTOWN NAVY YARD

Shadow Analysis of the Parcel 4 Hotel

INTRODUCTION

The study reflects the results of a shadow analysis of the Parcel 4 Hotel at the Charlestown Navy Yard. The study was conducted to determine the potential impact of the hotel on the surrounding area, including the Navy Yard, the Charlestown Navy Yard, and the surrounding area. The study was conducted by Sasaki Associates, Inc., and the results are presented in this report.

EXISTING AND PROPOSED CONDITIONS

The base condition study of the Charlestown Navy Yard includes the existing conditions of the base, including the existing buildings, the existing parking areas, and the existing infrastructure. The proposed conditions include the proposed hotel, the proposed parking areas, and the proposed infrastructure. The study was conducted by Sasaki Associates, Inc., and the results are presented in this report.

The proposed hotel is located on the Charlestown Navy Yard, and the proposed parking areas are located on the Charlestown Navy Yard. The proposed infrastructure includes the proposed roads, the proposed sidewalks, and the proposed utilities.

Prepared for: Boston Redevelopment Authority

Prepared by: Sasaki Associates, Inc.

Date: August 19, 1991

1. The study was conducted to determine the potential impact of the hotel on the surrounding area, including the Navy Yard, the Charlestown Navy Yard, and the surrounding area. The study was conducted by Sasaki Associates, Inc., and the results are presented in this report.

2. The proposed hotel is located on the Charlestown Navy Yard, and the proposed parking areas are located on the Charlestown Navy Yard. The proposed infrastructure includes the proposed roads, the proposed sidewalks, and the proposed utilities.

3. The study was conducted by Sasaki Associates, Inc., and the results are presented in this report.

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APPENDIX

The study was conducted by Sasaki Associates, Inc., and the results are presented in this report. The study was conducted to determine the potential impact of the hotel on the surrounding area, including the Navy Yard, the Charlestown Navy Yard, and the surrounding area. The study was conducted by Sasaki Associates, Inc., and the results are presented in this report.

INTRODUCTION

This study addresses the shadow impacts of the hotel proposed for Parcel 4 at the Charlestown Navy Yard. The focus of the study is on the shadows that fall on pedestrian and open space areas near the building. Open space areas of concern include First Avenue, Yard's End Park (which includes the entry plazas to the Biomedical Research Park and the New England Aquarium), and the Harborwalk.

EXISTING AND PROPOSED CONDITIONS

The base condition analyzed herein as "existing conditions" includes Buildings 114, 199, 75, 106, 4A as well as the addition to Building 114 and Building A of the Biomedical Research Center. According to phasing plans for the build out of the Yard's End area of the Navy Yard, all of these buildings will be completed or occupied when the hotel is built. Therefore, they are all included in the base condition analysis.

The proposed project is part of the Charlestown Navy Yard Redevelopment Plan. Uses studied in the Proposed Condition include the following:

Proposed Uses

- A 400 suite hotel located on Parcel 4 just north of the Pier 8/9 Marina.

Pedestrian Areas

- *Harborwalk* - a continuous pedestrian walkway along the water's edge providing a pedestrian link between the U.S.S. Constitution and the Aquarium and other Navy Yard uses.
- *Yard's End Park* - a park space and plaza located at the end of First and Second Avenues between the Aquarium site and Building A of the Biomedical Research Center.
- *First Avenue* - an auto and pedestrian route.
- *Sixteenth Street* - a secondary auto and pedestrian route.

METHODOLOGY

Shadows were projected for Parcel 4 hotel on four (4) key days of the year: March 21, June 21, September 21, and December 21 to establish a representative view of shadow impacts through the four seasons. Morning (9 AM), noon (12 PM), and afternoon (3 PM) shadows were diagrammed in order to understand the movement of shadows throughout each day.

Solar time was used to calculate the altitude and azimuth of the sun for each time, using geographical data about Charlestown (42°-23" N latitude, 71°-03" W longitude), the day length effects of the elliptical nature of the earth's rotation around the sun, and Daylight Savings Time. These factors result in solar time that can differ from clock time by thirty minutes or more. Daylight Savings Time was taken into account for June and September shadow calculations.

ANALYSIS OF IMPACTS

March 21: March 21 is the Vernal Equinox, the mid-point in the year when day and night are equivalent in length.

March 21/9:00 AM (EST)

At this hour, shadows will be cast from the hotel onto First Avenue reaching to Building 106.

March 21/12:00 Noon (EST)

The hotel continues to cast shadows onto First Avenue at this hour, although the shadows are considerably shorter and only segments of Building 106 are in shadow. Shadows also reach a portion of Sixteenth Street.

March 21/3:00 PM (EST)

Shadows from the hotel at this hour fall on the Aquarium site, and onto a very small portion of the Harborwalk.

June 21: June 21 is the longest day of the year when shadows are shorter than at any other time.

June 21/9:00 AM (EST)

At this hour, shadows from the hotel will be cast onto First Avenue reaching to Building 106.

June 21/12:00 Noon (EST)

The hotel continues to cast shadows onto First Avenue at this hour. The shadows do not reach to Building 106, however, and in fact largely fall only onto the sidewalk in front of the hotel.

June 21/3:00 PM (EST)

Shadows at this hour fall toward the Aquarium site.

September 21: Although September 21 is the Autumn Equinox, Daylight Savings Time is in effect and shadows are somewhat longer than they are at the same hour on the Vernal Equinox.

September 21/9:00 AM (DST)

Once again at this early morning hour, shadows fall from the hotel onto First Avenue and Building 106.

September 21/12:00 Noon (DST)

Shadows continue to fall onto First Avenue at this hour.

September 21/3:00 PM (DST)

Shadows fall directly onto the Aquarium site at this hour.

December 21: December 21 is the Winter Solstice when days are shortest, shadows longest, and outdoor activity is generally at a minimum.

December 21/9:00 AM (EST)

Shadows fall from the hotel onto First Avenue, Building 106, and even onto Building 75.

December 21/12:00 Noon (EST)

At this hour, shadows continue to fall onto First Avenue, Building 106, and onto part of Sixteenth Street and part of the Yard's End Park.

December 21/3:00 PM (EST)

The hotel casts shadows to the northeast at this hour fully across the Aquarium site and extending into the Harbor. The Harborwalk is impacted in two locations at this hour: along its easternmost edge and just south of the hotel.

CONCLUSIONS

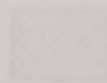
Every morning throughout the year, First Avenue will be in either partial or full shadow cast by the hotel. Every afternoon, except in the summer, shadows fall onto the Aquarium site. The shadows that fall onto the Aquarium site are primarily located on the entry area of the proposed Aquarium, with less shadow falling onto the skylit exhibit area. Very little shadow falls onto the Harborwalk from the hotel, and only in the winter do shadows fall onto the Yard's End Park.

MITIGATION

Shadows that fall on First Avenue would fall even with a building of much lesser height, and do not warrant mitigation. The small extent of shadow that falls on the New England Aquarium, however, should be monitored for its effect on the living environment within the exhibit area.

ML/jjm/11462/r-hotel

BUILD CONDITIONS SHADOW ANALYSIS
Charlestown Navy Yard
Parcel 4 Hotel



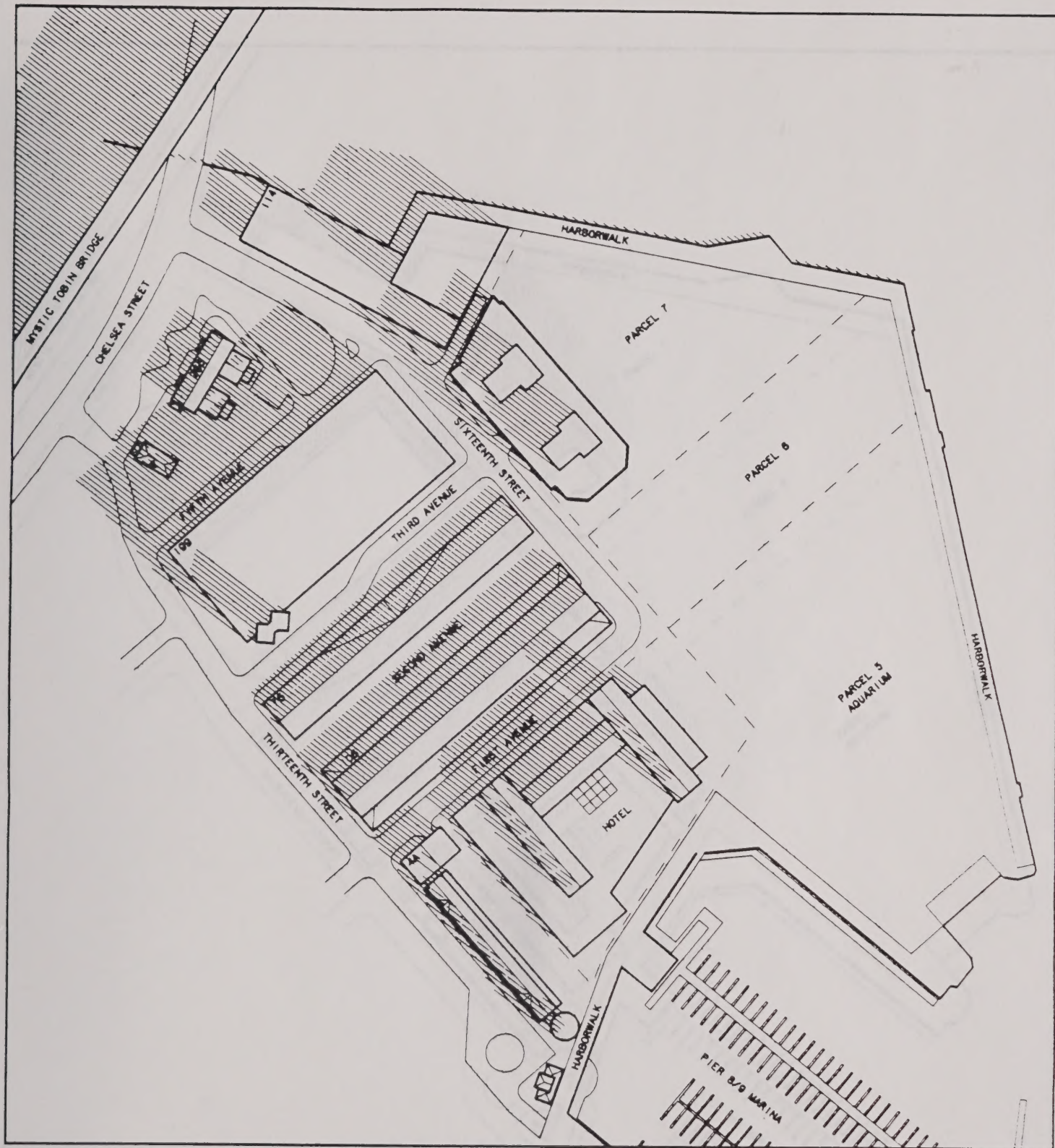


FIGURE: 1 BUILD CONDITIONS SHADOW ANALYSIS
 Charlestown Navy Yard
 Parcel 4 Hotel

MARCH 21, 9:00 AM
 BEARING: 127
 ALTITUDE: 33



200 0 200
 IN FEET

 BUILD CONDITION SHADOWS

PREPARED BY:
 SASAKI ASSOCIATES, INC.
 64 PLEASANT ST.
 WATERTOWN, MA. 02172
 15 AUGUST 1991

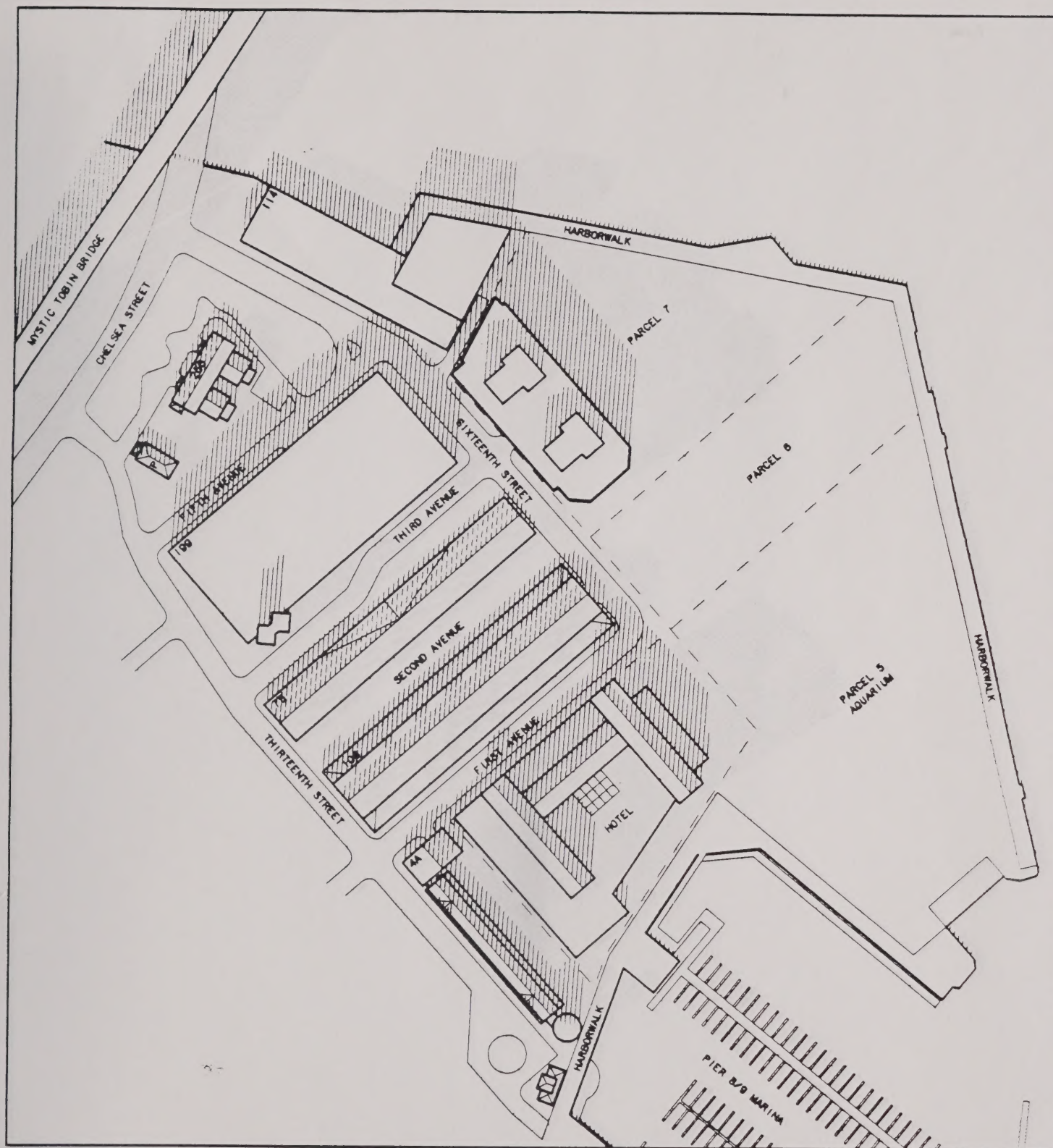


FIGURE: 3

BUILD CONDITIONS SHADOW ANALYSIS

Charlestown Navy Yard

Parcel 4 Hotel

MARCH 21, 12:00 PM
BEARING: 184
ALTITUDE: 48



BUILD CONDITION
SHADOWS

PREPARED BY:
SASAKI ASSOCIATES, INC.
64 PLEASANT ST.
WATERTOWN, MA. 02172
15 AUGUST 1994

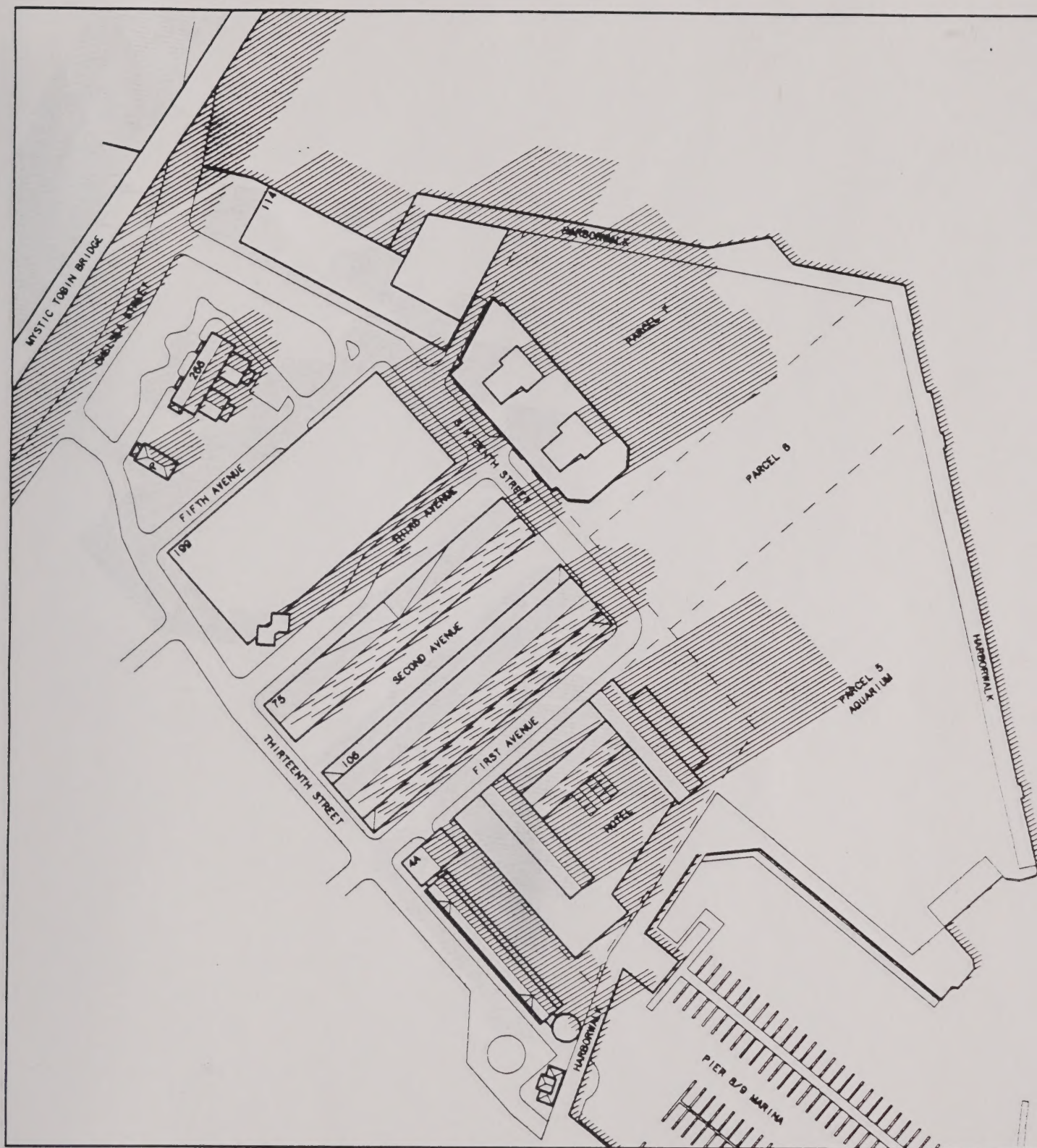


FIGURE: 5 BUILD CONDITIONS SHADOW ANALYSIS
 Charlestown Navy Yard
 Parcel 4 Hotel

MARCH 21, 3:00 PM
 BEARING: 238
 ALTITUDE: 30



BUILD CONDITION
 SHADOWS

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 SASAKI ASSOCIATES, INC.
 64 PLEASANT ST.
 WATERTOWN, MA. 02172

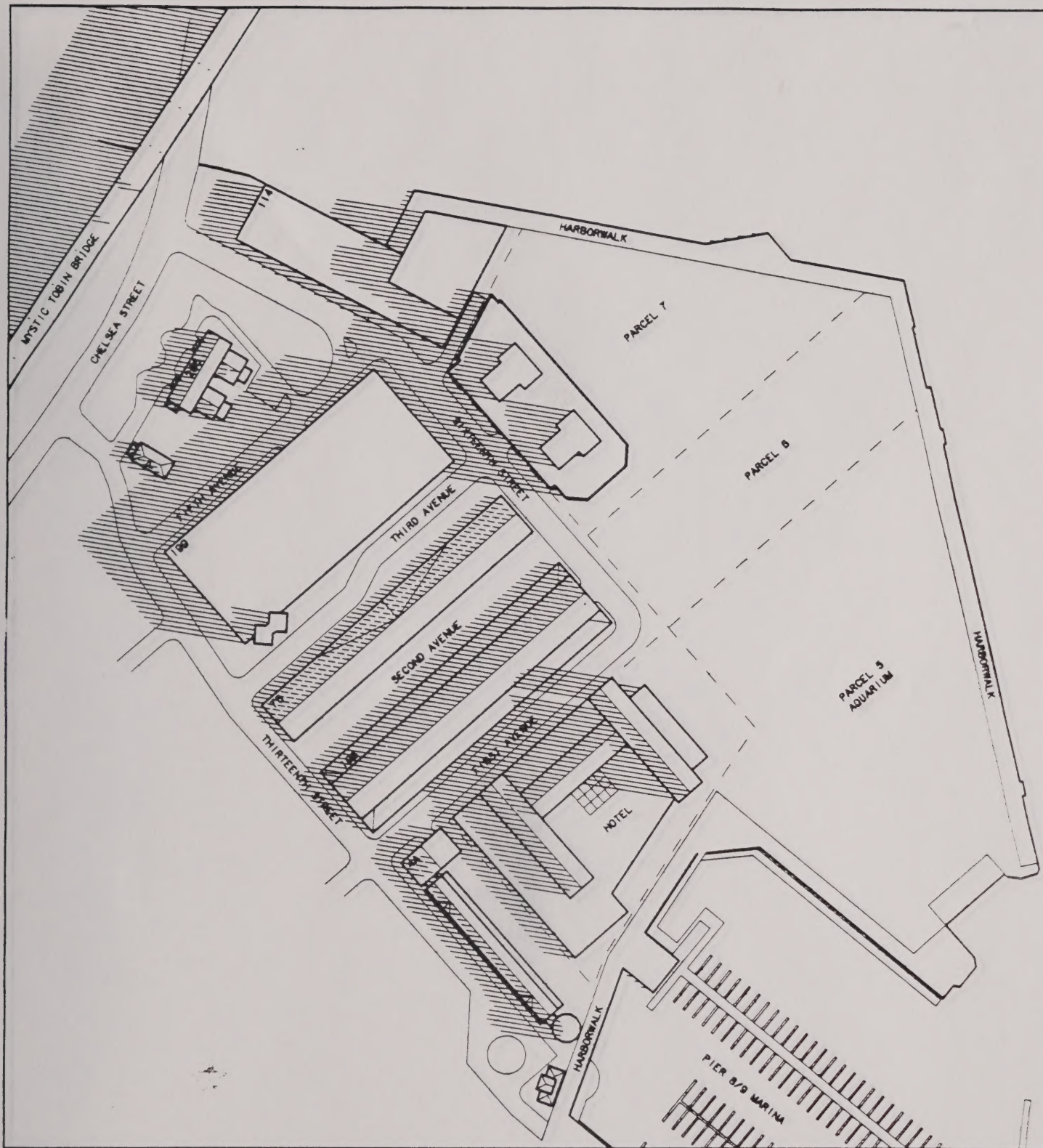


FIGURE: 7

BUILD CONDITIONS SHADOW ANALYSIS

Charlestown Navy Yard

Parcel 4 Hotel

JUNE 21, 9:00 AM
BEARING: 99
ALTITUDE: 40



BUILD CONDITION
SHADOWS

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SASAKI ASSOCIATES, INC.
64 PLEASANT ST.
WATERTOWN, MA. 02172

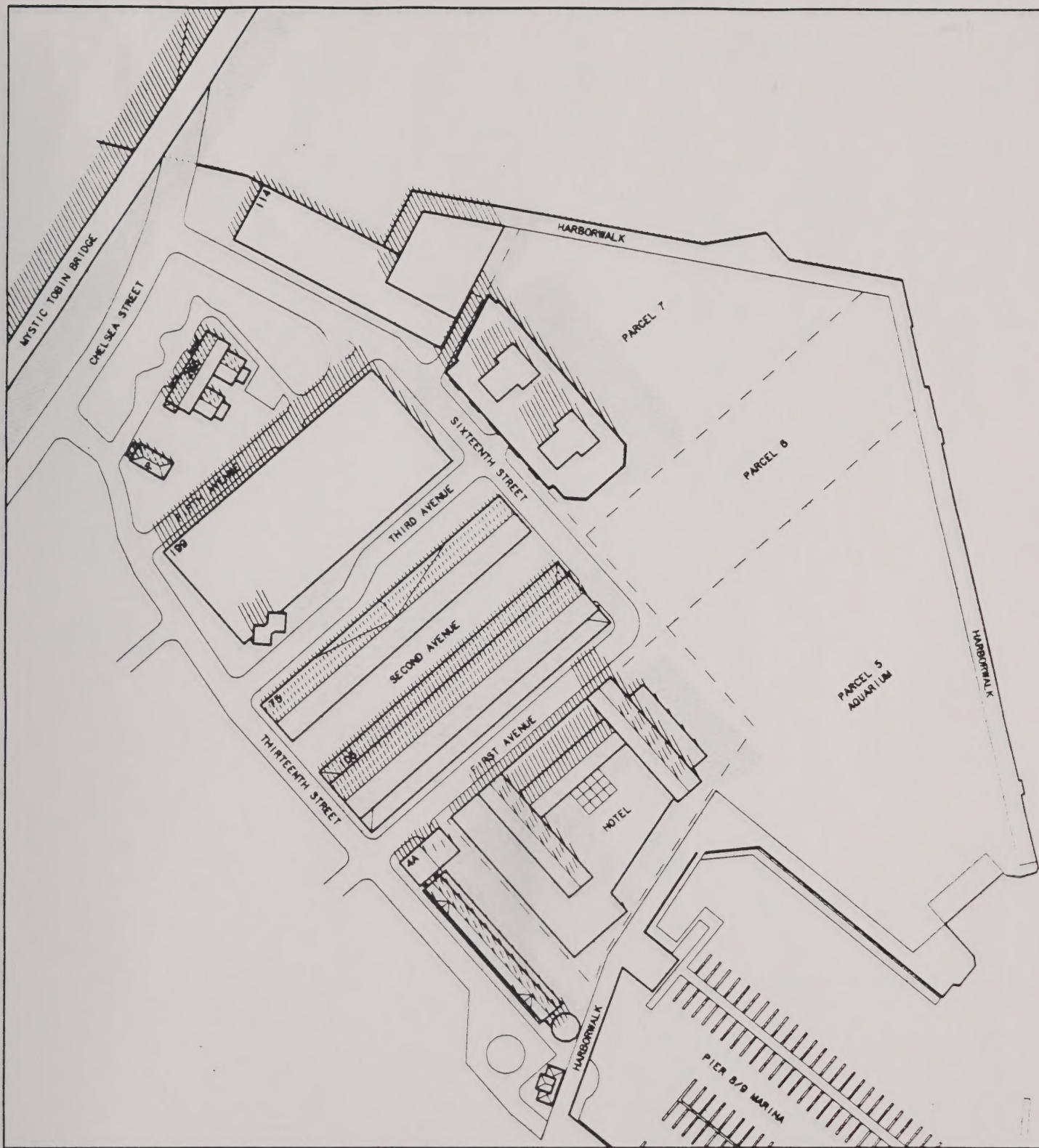


FIGURE: 9

BUILD CONDITIONS SHADOW ANALYSIS

Charlestown Navy Yard

Parcel 4 Hotel

JUNE 21, 12:00 PM
BEARING: 152
ALTITUDE: 69



BUILD CONDITION
SHADOWS

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SASAKI ASSOCIATES, INC.
64 PLEASANT ST.
WATERTOWN, MA. 02172
15 AUGUST 1984

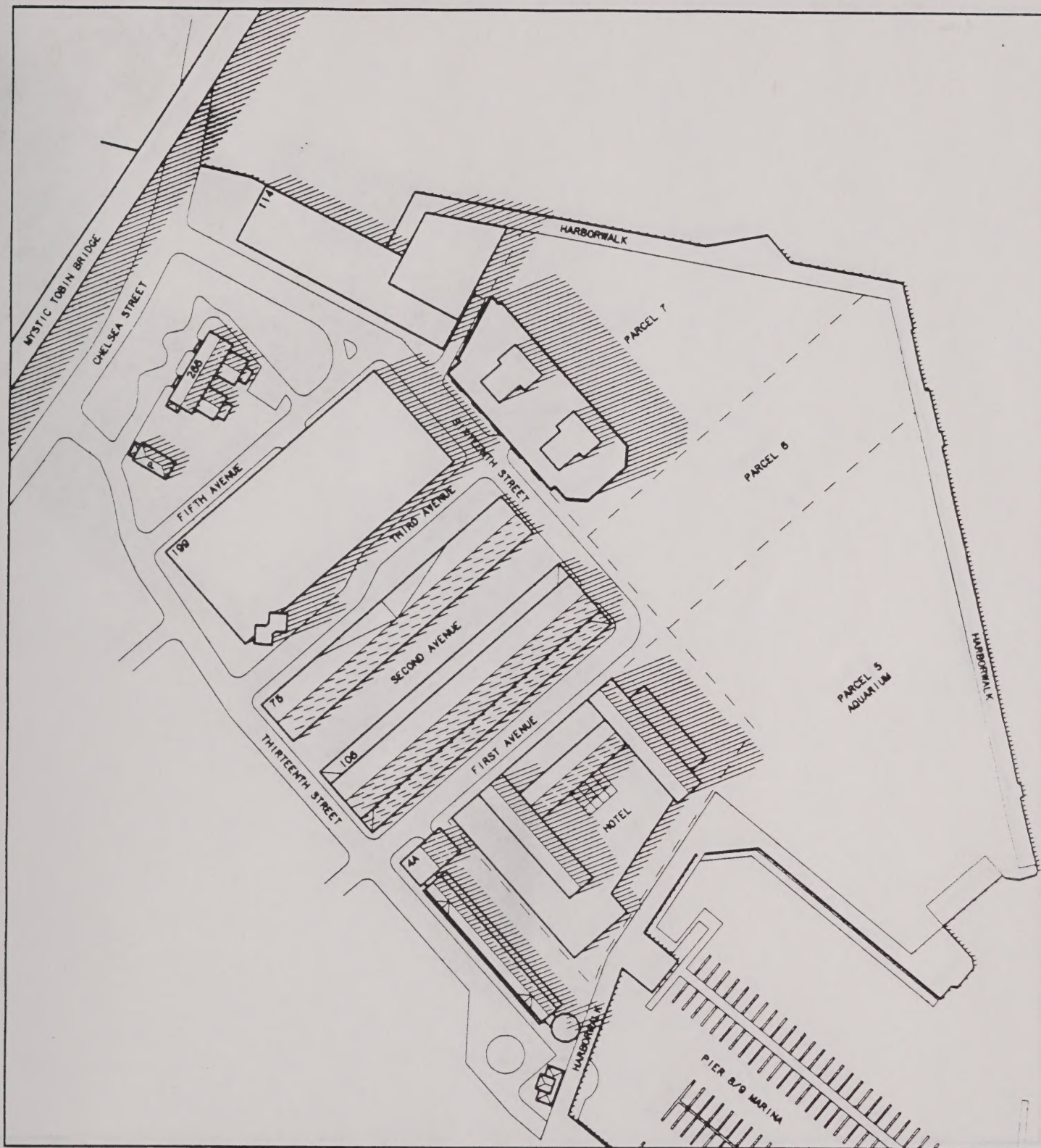


FIGURE: 1 BUILD CONDITIONS SHADOW ANALYSIS
 Charlestown Navy Yard
 Parcel 4 Hotel

JUNE 21, 3:00 PM
 BEARING: 248
 ALTITUDE: 56



BUILD CONDITION
 SHADOWS

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 SASAKI ASSOCIATES, INC.
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 WATERTOWN, MA. 02172

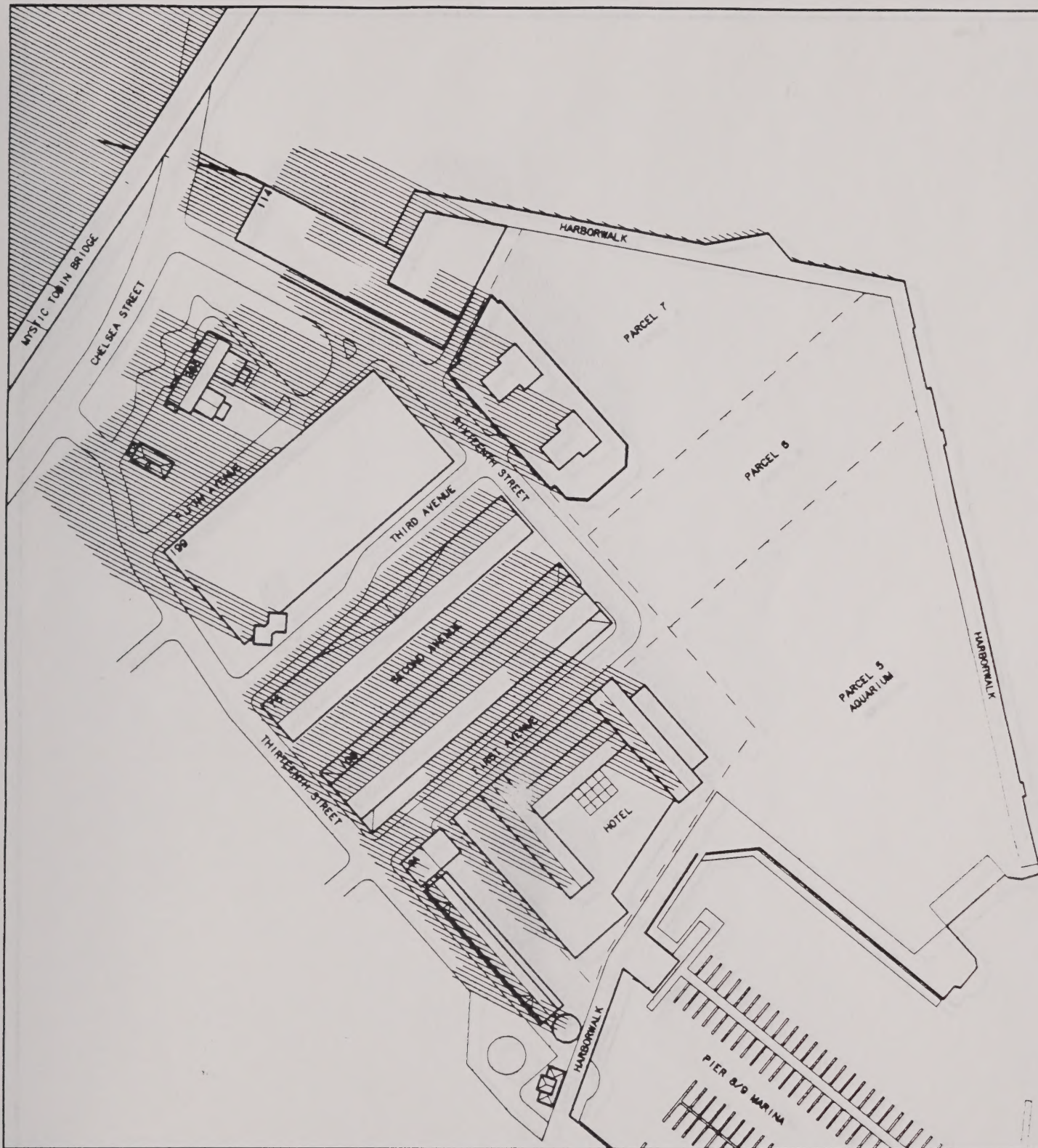


FIGURE: 13

BUILD CONDITIONS SHADOW ANALYSIS

Charlestown Navy Yard

Parcel 4 Hotel

SEPTEMBER 21, 9:00 AM
BEARING: 117
ALTITUDE: 27



BUILD CONDITION
SHADOWS

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SASAKI ASSOCIATES, INC.
64 PLEASANT ST.
WATERTOWN, MA. 02172

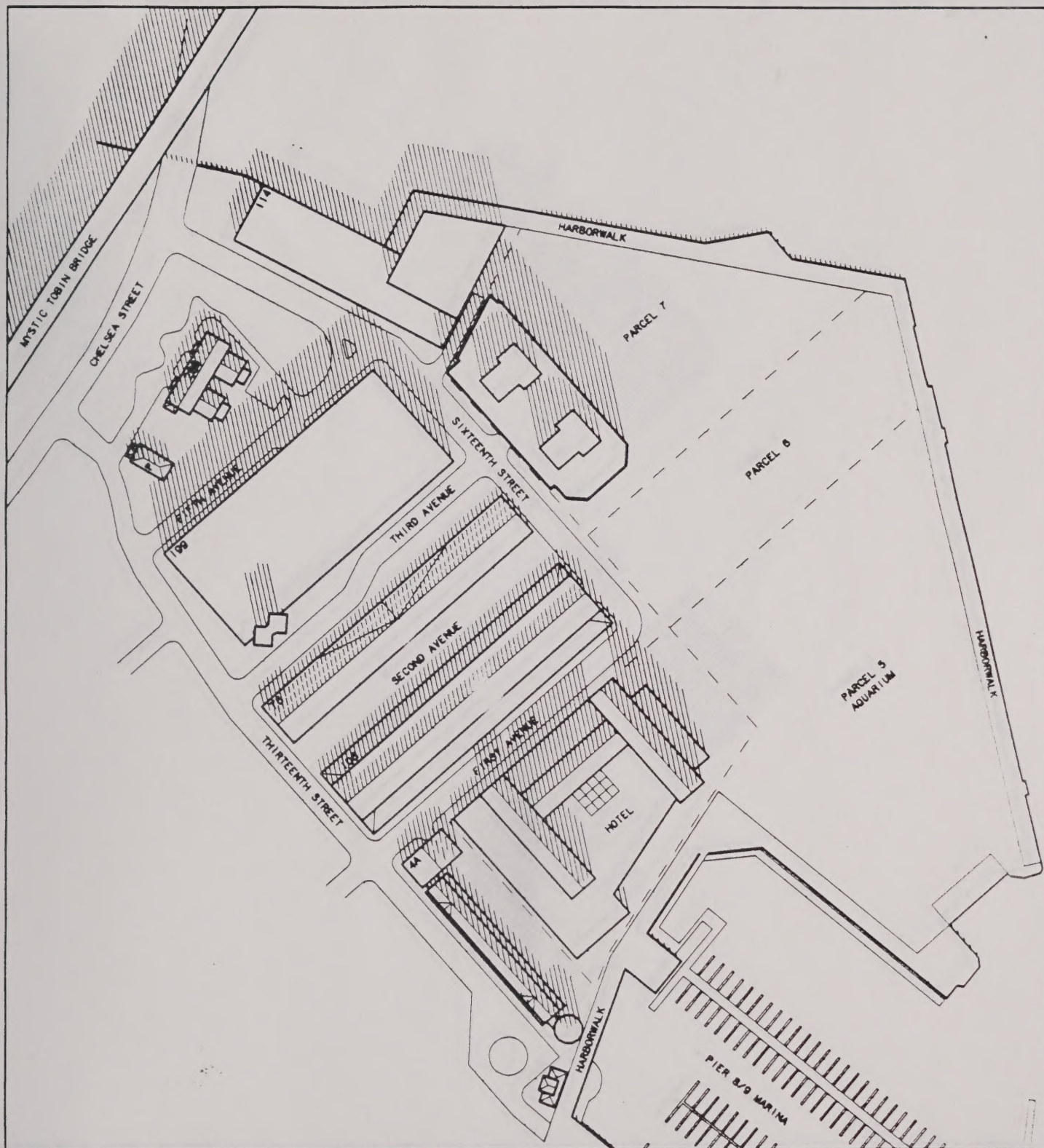


FIGURE: 15 BUILD CONDITIONS SHADOW ANALYSIS
Charlestown Navy Yard
Parcel 4 Hotel

SEPTEMBER 21, 12:00 PM
BEARING: 168
ALTITUDE: 47



BUILD CONDITION
SHADOWS

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SASAKI ASSOCIATES, INC.
64 PLEASANT ST.
WATERTOWN, MA. 02172

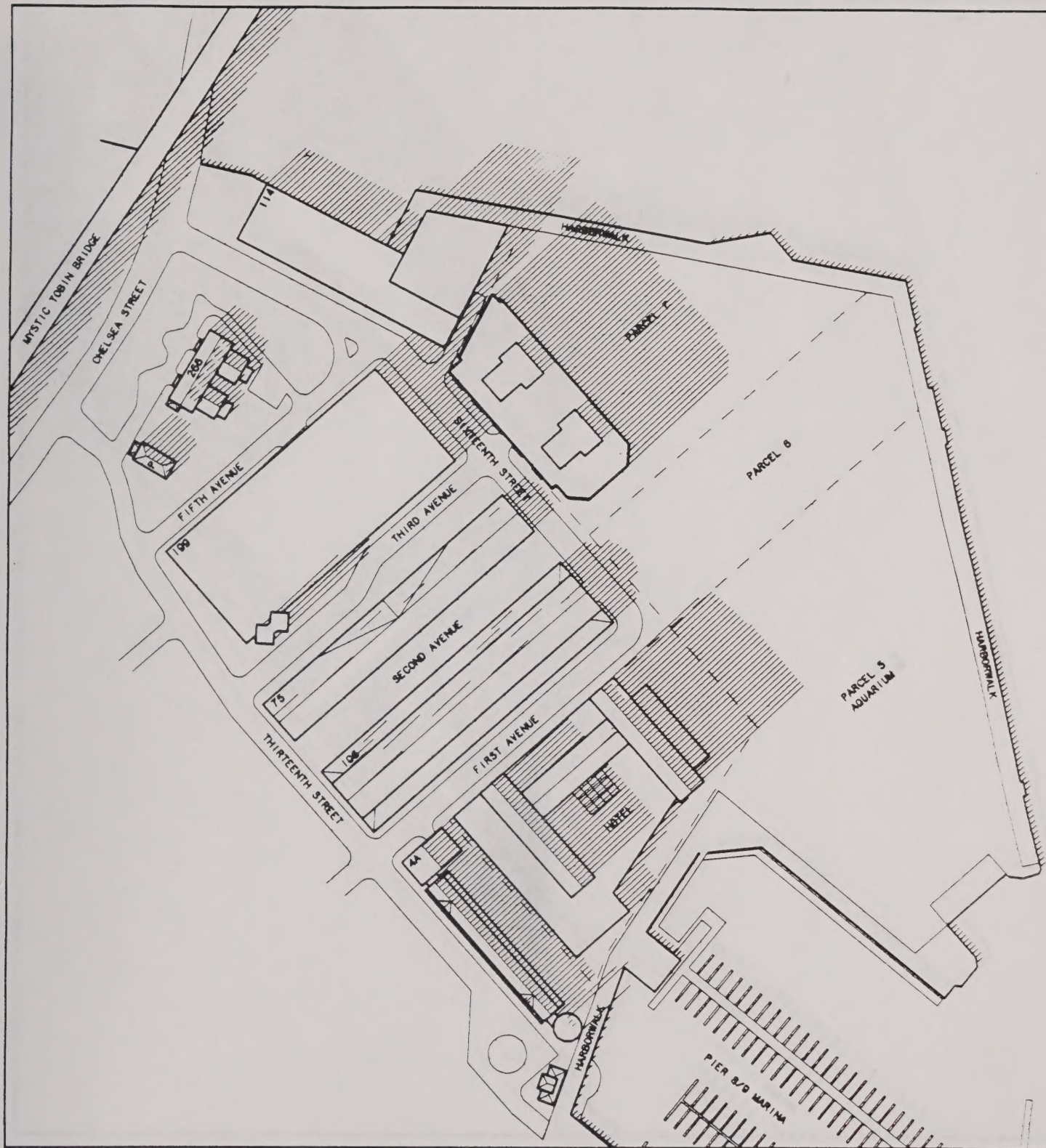


FIGURE: 17

BUILD CONDITIONS SHADOW ANALYSIS

Charlestown Navy Yard

Parcel 4 Hotel

SEPTEMBER 21, 3:00 PM
BEARING: 227
ALTITUDE: 37



BUILD CONDITION
SHADOWS

PREPARED BY:
SASAKI ASSOCIATES, INC.
64 PLEASANT ST.

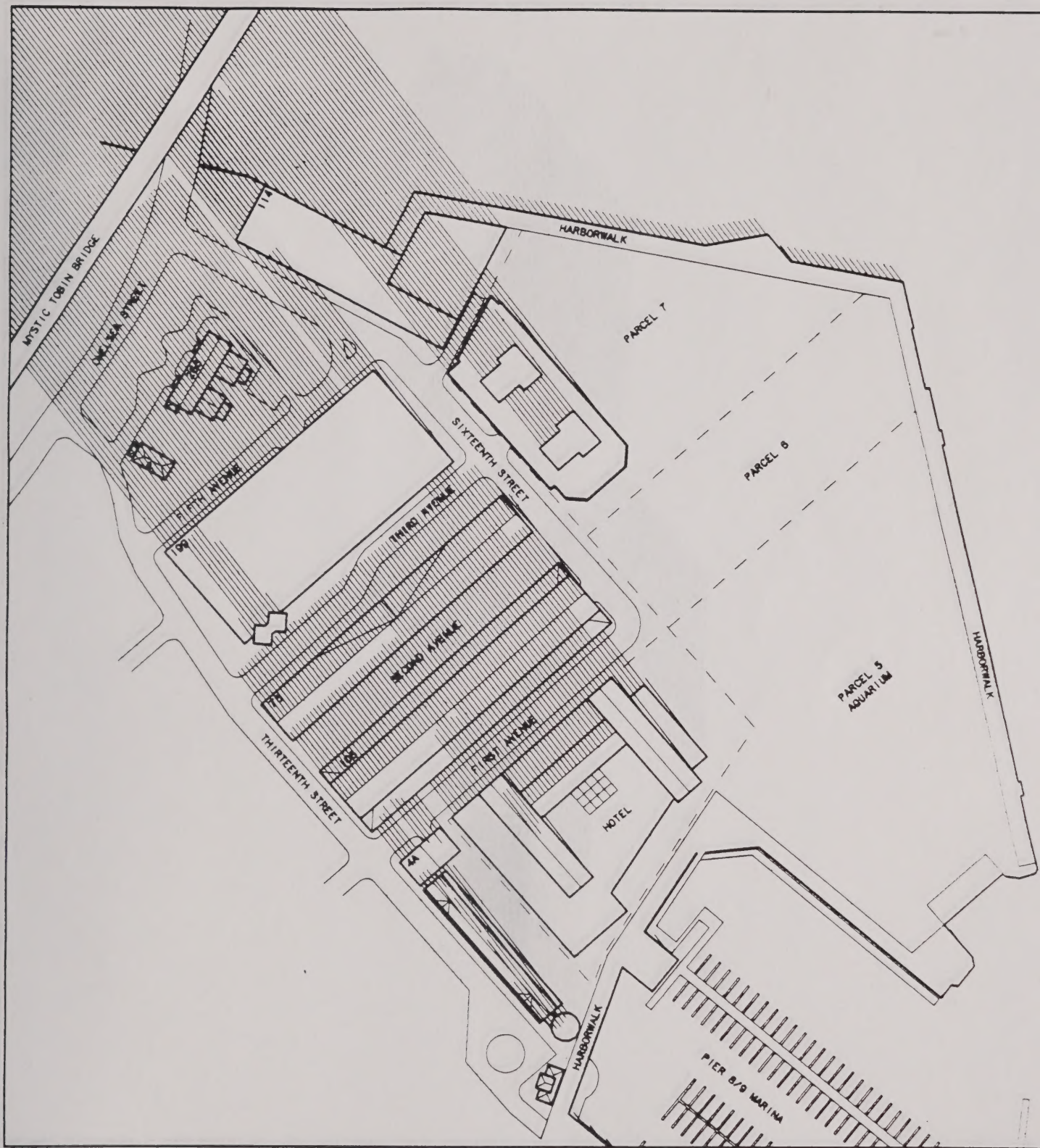


FIGURE: 19

BUILD CONDITIONS SHADOW ANALYSIS

Charlestown Navy Yard

Parcel 4 Hotel

DECEMBER 21, 9:00 AM
BEARING: 142
ALTITUDE: 15



BUILD CONDITION
SHADOWS

200 0 IN FEET

PREPARED BY:
SASAKI ASSOCIATES, INC.
64 PLEASANT ST.
WATERTOWN, MA. 02172
15 AUGUST 1991

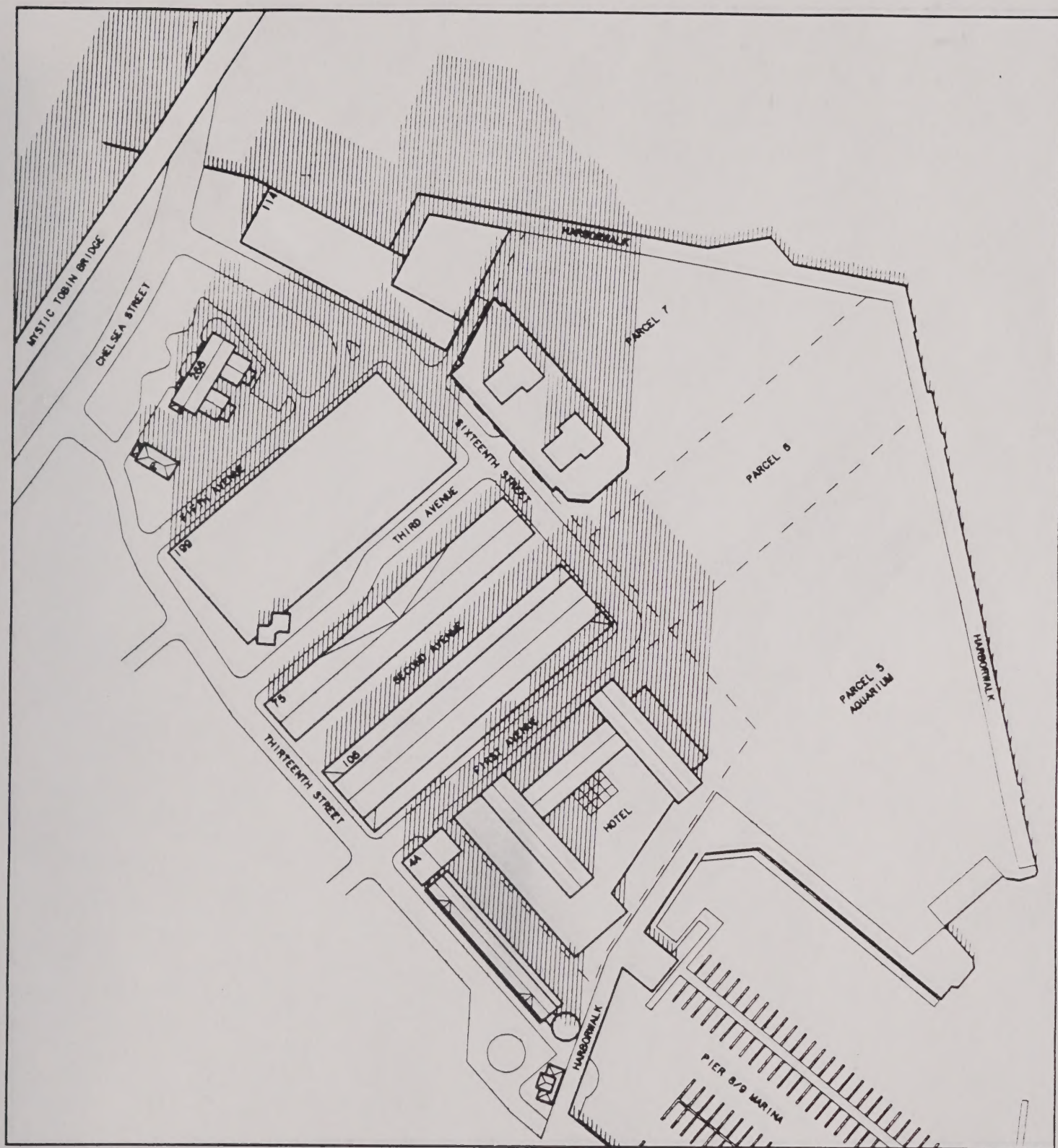


FIGURE: 21 BUILD CONDITIONS SHADOW ANALYSIS
 Charlestown Navy Yard
 Parcel 4 Hotel

DECEMBER 21, 12:00 PM
 BEARING: 183
 ALTITUDE: 25



BUILD CONDITION
 SHADOWS

200 0 200
 IN FEET

PREPARED BY:
 SASAKI ASSOCIATES, INC.
 64 PLEASANT ST.
 WATERTOWN, MA. 02172
 15 AUGUST 1991

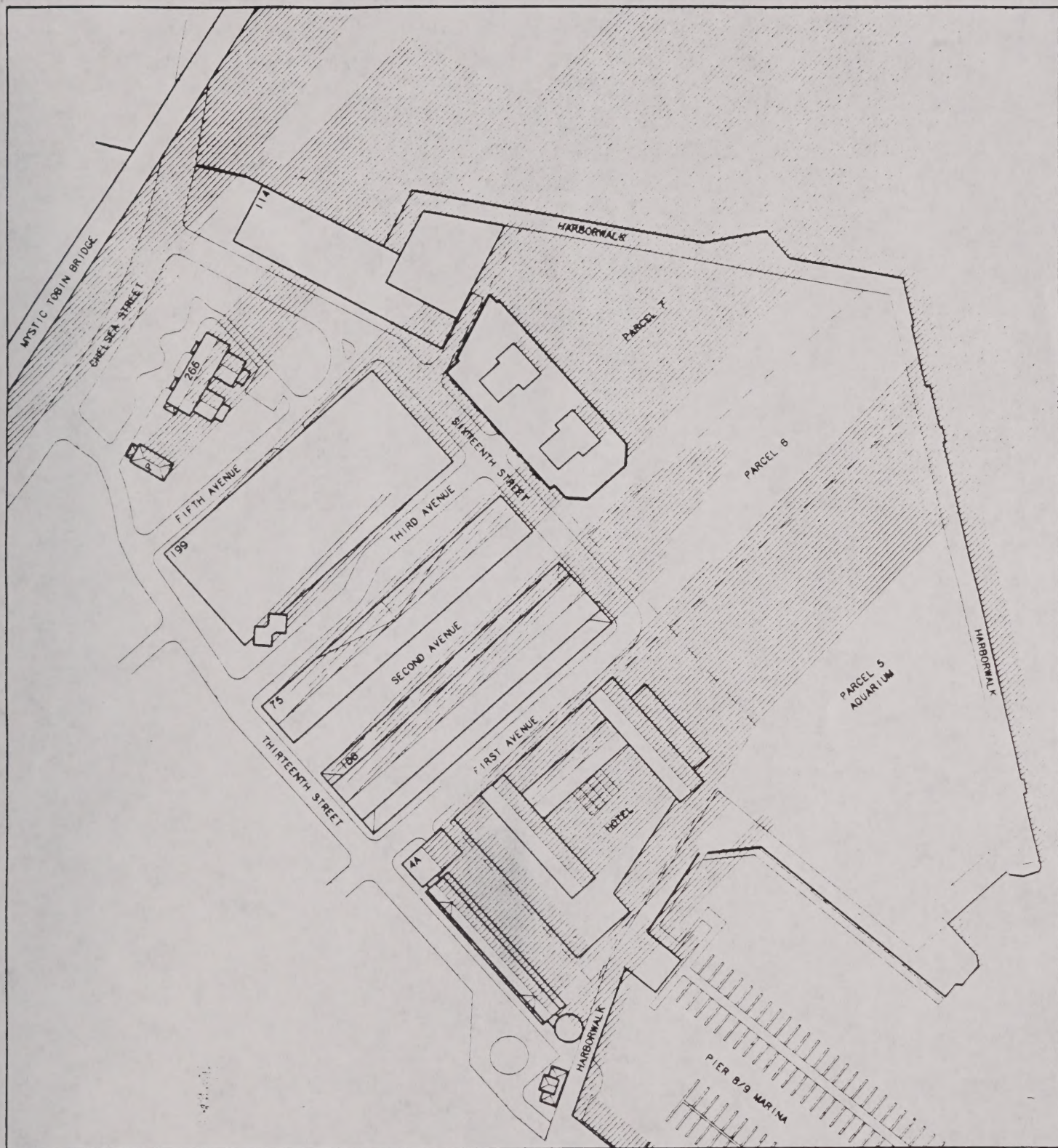


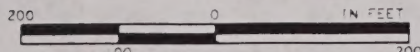
FIGURE: 23

BUILD CONDITIONS SHADOW ANALYSIS

Charlestown Navy Yard

Parcel 4 Hotel

DECEMBER 21, 3:00 PM
BEARING: 224
ALTITUDE: 11



BUILD CONDITION
SHADOWS

PREPARED BY:
SASAKI ASSOCIATES, INC.
64 PLEASANT ST.
WATERTOWN, MA. 02172
15 AUGUST 1991

